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A Glance at the Contents

Gas Changes at Derby.

Sir John Ferguson Bell has been elected Chairman, and Mr. J. P. McCrae has been appointed Engineer and General Manager, of the Derby Gas Light and Coke Company. [p. 72.]

Mr. Webb's Institution Paper.

We publish to-day a supplement by Mr. R. N. Webb to his paper "An Experiment in Controlling Pressure Conditions within Coal Gas Retorts" which he presented at the June Meeting of the Institution of Gas Engineers. [p. 87.]

Presentations to Mr. T. F. Canning.

Several presentations have been made to Mr. T. F. Canning upon his retirement from the position of Engineer and Manager of the Southend-on-Sea Company consequent upon its being taken over by the Gas Light and Coke Company. These were from his staff as well as from the Board of Directors. [p. 73.]

Wales and Monmouthshire Junior Association.

The third meeting of the session of the Wales and Monmouthshire Junior Gas Association was held at the Gas Offices, Cardiff, on Dec. 19—Mr. S. E. Brett (the President) presiding. A paper was read by Mr. R. R. Brown, of Cardiff, entitled "Viewpoints of the Gas Industry," in which he discussed various aspects of present-day gas utilization. [p. 98.]

Gas for Hot Water Supply and General Heating.

This was the subject of an interesting paper, an extract from which is published to-day, presented by Mr. E. L. Oughton, Sales Superintendent to the South Suburban Gas Company, at a meeting of the Institution of Heating and Ventilating Engineers at the Swedenborg Hall, Hart Street, W.C. 1, on Wednesday, Jan. 6. He dealt with a wide range of gas appliances that are now available for hot water supply and general heating purposes, illustrating his remarks with a number of interesting slides of apparatus and actual plant installed. [p. 95.]

Withdrawal of Gas from Coke Ovens.

Dr. G. E. Foxwell discusses the practicability of withdrawing through the centre of the charge the gases evolved during the carbonization of coal in coke ovens. [p. 82.]

Gas Industry Display at Charing Cross.

A display has been arranged by the Gas Light and Coke Company, London, on behalf of the whole Gas Industry, and may be seen at Charing Cross during the fortnight which commenced on Jan. 7. Domestic gas appliances are shown, and one of the newest exhibits is a refrigerator worked by gas. There is a model of the largest gas-works in the world—that at Beckton. Practical demonstrations will be staged every day. The making of gas mantles was shown on the first three days, and the making and working of gas meters on the next three days. [p. 80.]

The Preservation of Food.

In the issue of the "JOURNAL" for Dec. 16 there was published a letter from Mr. T. P. Bennett (who is an architect) on the subject of refrigeration, and in it he made the suggestion that it would be an advantage if opinions could be obtained on food preservation from eminent authorities of medicine and hygiene. A paper was read in 1928 by Mrs. M. A. Cloudesley Brereton before the Congress of the Royal Sanitary Institute, one section of which dealt with this topic; and as that paper is now entirely out of print, we have her permission to reproduce a portion of it. [p. 79.]

In Recognition of Mr. John Wilkinson's Work.

In the long history of the Nottingham Corporation Gas Undertaking, no more interesting gathering has been witnessed than that which was represented by the assembly, on the evening of the 5th inst., at the George Street Offices, of those who had been intimately associated with Mr. John Wilkinson in his work as Engineer and General Manager. Mr. Wilkinson was the recipient of a silver rose bowl and silver flower vases, which were handed to him, on behalf of all sections of workers in the Engineer's Department, by Alderman Sir Albert Ball, Chairman of the Gas Committee, and generous tributes were paid to his work. [p. 72.]

TO THE GAS INDUSTRY IN THE MIDLANDS

The growth of our interests, embracing as it does the extension of the service provided by the "GAS JOURNAL," "Gas Salesman," and the new Calendar and Directory, has required certain changes in our Organization in the Midlands to meet the large amount of extra work involved. We have pleasure in announcing that we have been able to secure the services of Mr. John H. Moss, who is well known in Trade Journal Circles throughout the Midlands. His journalistic and advertising knowledge will enable him to be of great direct service to every firm with interests in the business we cater for.

Mr. Moss will become our District Manager for the area, and may be communicated with at 111, Wheelwright Road, Erdington, Birmingham; telephone: Erdington 1070.

Mr. R. E. Gibson, who has been our Advertising Representative for some years, will of course still conduct his business with the many friends he has established in the area, so far as advertising is concerned.

EDITORIAL NOTES

Through Coal or Coke?

"DEGRADATION of hydrocarbons," the "plastic layer," "evolution of gases in the coke oven"—these are subjects on which many papers have been written and many investigations based. A worker well known in this field of research is Dr. G. E. Foxwell; and readers will find in this issue of the "JOURNAL" an important article by him, prepared at our request, on the practicabilities of withdrawing from the centre of a charge of coal in a coke oven the gases produced during carbonization. The reason why we asked Dr. Foxwell to contribute this article, in which he sets out his opinions clearly, is that during recent years several patents have been taken out for methods of withdrawing the gases from the interior of the coal by embedding the gas offtake pipe in the coal charge itself. In particular we have the recent British Patent granted to Dr. Carl Still in which the gases are to be withdrawn from the chamber by tubes provided with slots which are sunk into the interior of the coal.

The author of the article under review describes how he tackled the problem from theoretical calculation and confirmatory laboratory experiment. In the first place he discusses the changes which a coal undergoes when it is subjected to high-temperature carbonization, with reference to the plastic layer, taking coals yielding a plastic layer of high resistance and those yielding one of low resistance. In regard to the former, he points out that with most coking coals the plastic layer, in normal practice, acts as an impermeable barrier between the hot and the cool zones of the oven. As to the low-resistance plastic layer, even here, unless a considerable suction is applied to the coal from inside the charge, the bulk of the gases will still pass upwards through the hot coke against the oven wall. A conception of the suction required with coals yielding a plastic layer of high resistance is gained if we give the figures ascertained by the author—between 1000 and 3000 mm. W.G. Moreover, the resistance of the plastic layer does not remain constant throughout the carbonizing period; and "the practical significance of this variation is to render any process for withdrawing the whole of the gases from the centre of the oven impossible. . . . When carbonizing a good coking coal, the suction required must evidently be between 1000 and 3000 mm. W.G., and at times this suction will be so much too great that volumes of furnace gases will be drawn in from the flues, whereas at other times it will not be sufficiently great to prevent loss of distillation gases to the flues." The general conclusion drawn is that any process for withdrawing the gases in the coke oven from the centre of the charge, although subject to difficulties, may be effective with coals having a low plastic resistance, but cannot be practicable with coals having a high plastic resistance.

Then the author appears to query the object of withdrawing part of the gases evolved through the centre of the coal charge. The tar obtained would be a mixture of high-temperature and low-temperature tar—a sort of hybrid product which must prove a definite handicap to the process under consideration. It would not be so suitable as high-temperature tar for road purposes; and though uses may be found in the future for low-temperature tar, it will be just as great an objection for it to be mixed with high-temperature tar as it is now for the latter to contain any low-temperature product. Again, the benzole obtained is greatly contaminated with paraffinoid bodies, and while quite suitable for motor fuel would be unsuitable for the dye industries. The lower decomposition of the tar naturally reduces the gas yield, though the calorific value of the gas is enhanced. A yield of 61 therms per ton is quoted by Dr. Foxwell. The final conclusion drawn from the author's detailed investigation is that a process involving the withdrawal of the gases from the centre of the charge in a coke oven is impracticable with the great majority of coals and is not of great value even for coals of low plastic resistance, because it produces tar of an inferior quality. The only value that it can have is for coals of low plastic resistance, which are also charged into the oven in a wet state. When using the internal pipe the water is evaporated early in the carbonizing period. If the water is withdrawn from the centre of the charge it will not pass against the oven wall, and, therefore, it will not absorb the considerable amounts of heat that it does in the ordinary coke oven process. Dr. Foxwell's findings will, we believe, prove of value to our readers, from whom we invite criticism or comment.

Phrases that Become a Habit

THE idea that every-day matters must be made "interesting" has become so deeply implanted in the modern system that even our news paragraphs are served hot with little improvements designed to give them additional life and colour. Work is done at high speed, and inevitably at times certain words and phrases will recur with irritating frequency. Examples will spring to the mind of every newspaper reader of much-respected words which, by their use both in season and out of season, have been driven to death; but as a rule the irritation which the process causes is the only ill-effect. There are, however, cases in which phrases, rather than words, are apt to be reiterated without sufficient heed being given to the meaning that is likely to be attached to them, and then injustice may more easily result.

An example of this latter type of error is the newspaper heading which announces that a town is "in darkness," or has been "plunged in darkness." Time and again does this occur, because of the liability to failure which electricity still persists in demonstrating. The error is not in imputing blame to electricity, but in giving the impression that the failure has put "in darkness" the place concerned. Few towns are there of any size where gas is not much in evidence for purposes of illumination, and to the gas undertaking—the provider of a thoroughly reliable twenty-four hour per day service—the thoughtless phrase "town in darkness" when the electricity supply fails is not quite fair. This was the case a few days ago, when abnormal rainfall caused considerable flooding in the West of Scotland, with consequent dislocation of traffic and loss of property. Here is what a local paper reported: "There were remarkable scenes in Kilmarnock, where the Irvine broke its banks and eventually flooded the electricity station, so that the town was in darkness."

The impression thus conveyed was in this particular instance very quickly challenged. Electricity had not been, it is true, avoidably in fault, but neither did it have the power attributed to it to "put the town in darkness." The floods became so menacing that the Manager of the power station ordered the men to withdraw for their own safety, which was the reason for the cutting off of the supply by the Ayrshire Electricity Board. But Kilmarnock has a gas-works, and this is what Mr. Charles Fairweather (the Engineer and Manager) replied to the "town left in darkness" statement: "In fairness to all those men of the Kilmarnock Corporation Gas Department (situated immediately alongside the works of the Ayrshire Electricity Board), who worked so splendidly to maintain the full supply of their Department's service, under difficult and dangerous conditions, I feel it my duty, on their behalf, to point out

that the gas supply of Kilmarnock was maintained in full throughout, with the single exception of a small portion of the flooded area, where the gas main was unfortunately flooded and inaccessible."

A few days earlier it had elsewhere been announced that Southampton was "in darkness," because of a failure of the electricity supply. One imagines that the gas supply continued to function, and that had it been installed in one particular place the following would not have appeared in the Press: "When Southampton's electricity supply failed last night, an operation was completed in the casualty ward of the Royal South Hants. Hospital by the light of candles and a policeman's torch. The operation was on a workman injured in an accident."

Modern Gas Appliances

In spite of our showrooms and our publicity, a vast section of the public remains ignorant of the developments which have been made in the construction of gas-burning equipment; the same can be said of many architects and builders, and of heating engineers. Consequently we are glad that the New Year has already been marked by the presentation of certain facts which ought to be well known to every heating engineer. The idea of getting away from our immediate circles and discussing gas utilization with kindred societies is excellent; and it is to be hoped that more opportunities will be taken of giving popular talks to organizations such as the Rotary Club. On Wednesday last the Institution of Heating and Ventilating Engineers heard a paper by Mr. E. L. Oughton, Sales Superintendent to the South Suburban Gas Company, on gas for hot water supply and general heating, in which the author gave much information on modern gas equipment for different situations, and a useful set of fundamental data, including the relationship of the therm and the cubic foot, which, though necessarily familiar to those in the Gas Industry, is by no means universally understood by the members of general engineering societies.

An extract from Mr. Oughton's contribution, together with a report of the discussion on it, will be found on later pages of our issue to-day. The keynote of the paper is that there exists some form of gas appliance capable of satisfying every demand. In the water heating field, for instance, there is an appliance for every type of job, and there is no problem which cannot be adequately solved to the satisfaction of the consumer—provided the appropriate apparatus is fixed for each individual situation. This is the basis of good salesmanship; and it has to be remembered that there are salesmen of gas apparatus not only within the Industry, but outside it—we refer, of course, to architects and builders and to heating engineers and plumbers. How necessary, therefore, that they should be fully aware of what the Gas Industry has to offer and what exactly each appliance will and will not do. Half the troubles encountered on the district would never have occurred if this consideration had been remembered. The virtues of gas for water heating are many. With modern appliances the bills are strictly proportional to the amount of hot water used; the temperature of the water to be drawn off is under control; and so on. But the greatest advantage, to our mind—and one which ought to receive much more publicity—is that one can accomplish with gas what cannot be accomplished by solid fuels or at all easily by electricity.

A further important advantage is that gas units may be used as auxiliary sources of hot water supply—a feature often particularly useful during the summer months. We have always maintained that "gas *versus* coke" is quite a mistaken attitude for the Gas Industry to take up. In his paper Mr. Oughton mentions the increasing use of gas for steam raising in many industries where special process work demands a comparatively small amount of steam at a higher pressure, perhaps, than the large coke-fired boiler gives, and to increase this pressure would not be economical—*e.g.*, moulding presses for bakelite, casine, and similar products, in which case a compact layout with a closed circuit is both efficient and economical. This is only one of many uses. Again, where a process has a varying or low load factor, the automatic control of gas in the "off" periods makes the gas-fired boiler a necessity if economy is appreciated. The author quoted an interesting example to show the utility of gas for central heating, and explained to his audience the new system of air heating by gas—in regard to which application we are rightly following the lead set by the American Gas Industry. Such items from Mr. Oughton's comprehensive paper are not well enough known at present; and we trust that during this year full opportunity will be taken of telling "outside" bodies about the enormously enlarged possibilities of service of the Gas Industry of 1932.

An Income-Tax Problem

The daily papers have been regaling us with many statements highly creditable to the British taxpayer, in connection with the meeting of the demands of the Exchequer. Indeed, it seems that many members of the sorely tried public have gone beyond meeting the strict demands, exacting as they are. Numerous examples have been quoted, not only of people paying the next July instalment as well as that due this month, but of gratuitous additions being made to help the Budget. All of which goes to demonstrate the wonderful spirit of the nation. It can be truthfully said of the British people that never are they so great as in adversity.

But with all this eagerness to assist, it would be a thousand pities if those who find spending so easy were to overlook for a single moment the greatness of the sacrifice that has to be made, and it would be no less regrettable should the people themselves have their attention diverted from the position as it really is. These considerations have some bearing upon the magnificent response that has been made by income-tax payers throughout the land, and also upon some points which have been raised by the "Financial Times" on the subject of charging income-tax at the source. On the question of whether the income-tax load could be adjusted with advantage more evenly to the shoulders which bear it, our contemporary weighs the advantages against the disadvantages of an extension of the practice of deduction at source to all salary and wage earners. There are many things to be said in favour of such a course. To our mind, the main disadvantage is excellently set out in these terms by the "Financial Times" writer: "It would assume in part the nature of concealed taxation, of which the individual would be less conscious by the fact of non-receipt than if the gross income passed through his hands and a large slice had to be paid over for State services, as happens now. The political pressure for an economical Administration might be less, as in truth it has been in municipal areas which have levied heavy rates for wasteful purposes and have been supported in office by householders ignorant of the true relationship between rates and rent in the weekly payments for their tenancies. An elector who is fully conscious of the drafts made upon his income is more likely to be an active constructive force than one who is not, and the national wellbeing demands the maximum of such activity."

It has, of course, to be remembered that already many large staffs have deductions made by their employers out of periodical salaries or wages payments, and find the method convenient. Also that some saving of time and money to the authorities might be anticipated. But our inclination is towards the development of a feeling of personal responsibility, and we still wonder if there would not be some danger of this development being interfered with by general adoption of the practice of charging income-tax at source.

The "Journal" Index.

Subscribers are advised that the index for Vol. 196, covering the three months October to December, 1931, will be included with next week's issue of the "Journal."

PERSONAL

To mark his departure from their service to Lancaster, where he has been appointed Gas Manager, the Johnstone Town Council have presented Mr. W. A. DEARDEN, their ex-Manager, with a silver salver.

A wristlet watch and a cigarette case were presented to Mr. JOHN ADAMS, of Greenock Corporation Gas Showrooms, by his fellow employees prior to his leaving to take over the managership of the Luton Gas Company's Showrooms.

Major RICHARD MILES and Mr. R. W. BROADHEAD have been appointed Local Directors of Messrs. Newton, Chambers & Co., Ltd. The latter is retaining his position of Managing Director of Broadhead Constructions, Ltd.

Mr. HERBERT WILLIAM ROBINSON, Chairman of Messrs. Robinson Bros., Birmingham, Midland Tar Distillers, left £49,176 (net £37,566).

DERBY GAS CHANGES.

Sir John Ferguson Bell as Chairman and Mr. J. P. McCrae as General Manager and Engineer.

Important changes in the management of the Derby Gas Light and Coke Company were made at a recent Directors' meeting. Mr. WILLIAM WOOLLEY resigned the Chairmanship of the Directors, and Alderman Sir JOHN FERGUSON BELL, who retired from his post as General Manager and Engineer at the end of the year, was appointed in his place and was also made Managing Director. Mr. J. P. MCCRAE, the Assistant Engineer, was appointed to the chief executive position in Sir John's place.

Mr. Woolley has been the Chairman of the Company for ten years and a Director for thirty. During his Chairmanship the Company has been most successful, thanks partly to his wise guidance and foresight. He will remain a Director.

Sir John Ferguson Bell has also contributed largely to the success of the undertaking, for he has combined the comprehensive knowledge of an engineer with a keen capacity for present business and a shrewd and enterprising eye for future planning and development. He has been General Manager and Engineer of the Company for 31 years, and during that period rapid progress has been made. The area of supply is now over 100 square miles, and the Company is acknowledged to have one of the most progressive and successful undertakings of its kind in the country.

Sir John has been the Chairman of the Derby Water Committee for many years, and is the Chairman also of the River Improvement Committee—two offices in which his technical knowledge has been of great service to the town. Three years ago he was the Mayor of Derby, and in the following year he generously completed the second half of the mayoral term following the sudden death of Alderman J. H. H. Grant. Last summer he was knighted. Though now 75 years of age, he is a very active man.

Mr. McCrae, the new General Manager and Engineer, is a native of Dundee, where his father and grandfather before him were Engineer and Manager of the Gas Undertaking. After being educated at Dundee High School he became a pupil at the Dundee Gas-Works, at the time when the works were re-constructed. He passed through the works office, drawing office, and laboratory, before being appointed Assistant Manager to the Hexham Gas Company. He studied gas engineering and allied subjects at Rutherford College, Newcastle-on-Tyne.

For some years Mr. McCrae had charge of the Gas-Works of the Great Northern Railway before being appointed Assistant Gas Engineer to the Doncaster Corporation. He continued his engineering studies until 1916, when he was appointed Assistant Engineer at Derby. Extensive engineering works have been carried out at Derby during this period, and in addition to acting as Works Manager at the Cavendish Street Works and the Belper Works, Mr. McCrae has been intimately associated with the distribution and sales side of the Company's business.

GAS RESEARCH FELLOWSHIP.

Mr. T. H. BLAKELEY has been elected to the Gas Research Fellowship endowed by the Institution of Gas Engineers, which has been rendered vacant by the appointment of the previous holder, Dr. A. H. Eastwood, to the staff of the Joint Research Committee of the Institution and the University of Leeds.

Mr. Blakeley came from the West Leeds High School with a Senior City Scholarship to the University of Leeds, and graduated B.Sc. last July with 1st class Honours in Gas Engineering, being awarded the Le Blanc Medal for distinction in Applied Chemistry. He had carried out an investigation into the thermal conductivity of materials used for the insulation of high-temperature furnaces, and was author, along with Prof. Cobb, of a paper on that subject read at Sheffield on Dec. 14 before a joint meeting of the Yorkshire Section of the Society of Chemical Industry and the Refractories Association. As holder of the Fellowship, he will undertake further research work in the University under the direction of the Livesey Professor of Coal Gas and Fuel Industries, on the reactivities of carbonized fuels at high temperatures.

NOTTINGHAM PRESENTATION TO MR. JOHN WILKINSON.

"A Man of Unblemished Integrity."

In the long history of the Nottingham Corporation Gas Undertaking, no more interesting gathering has been witnessed than that which was represented by the assembly, on the evening of the 5th inst., at the George Street offices, of those who had been intimately associated with Mr. John Wilkinson in his work as Engineer and General Manager. Mr. Wilkinson's retirement, which took place at the end of the year (when he was succeeded by Mr. George Dixon), led to a striking manifestation of the regard in which he is held, alike upon the score of his professional and personal attributes. A subscription which had been organized by Mr. G. Curtis (Superintendent of the Woodborough Road Distribution Department), Mr. J. W. Fells (Superintendent at the Basford Works), Mr. E. W. Morrisson (Superintendent at the Eastcroft Works), Mr. F. B. Whitehead (chief of the clerical staff in the Engineer's office), and Mr. L. Lever (of the Radford Works), resulted in the presentation to Mr. Wilkinson of a silver rose bowl and silver flower vases, which were handed to him, on behalf of all sections of workers in the Engineer's Department, by Alderman Sir Albert Ball, Chairman of the Gas Committee. Generous tributes were paid to the recipient, who was referred to as a man of unblemished integrity, who had served the interests of the city with unswerving fidelity.

Sir Albert Ball referred to the great pleasure which it had afforded him to be associated with Mr. Wilkinson in his management of the undertaking during the past twenty years. Mr. Wilkinson had brought the works to the greatest state of efficiency, and his high professional qualifications and the esteem in which he was held by all who were connected with the gas engineering profession were indicated by the fact that he had been accorded the highest honour which it was possible for them to confer by his selection for the Presidency of the British Institution of Gas Engineers. No man could have worked harder or more conscientiously in the interests of Nottingham than Mr. Wilkinson had done. Personally, he could not say all that he should like to do in relation to Mr. Wilkinson; but he had proved a true friend, and one of the best men whom he had ever met. He sincerely hoped, as he was sure they all did, that Mr. Wilkinson might yet be spared for many years to add possibly still further to the great work which he had already accomplished.

Mr. Wilkinson, in reply, expressed his great appreciation of the gift and of the kindly feelings which had prompted its presentation. Save in regard to one black spot, it had been his pleasure to have the co-operation of a loyal staff, without whose help it would have been impossible to attain the results which had attended the working of the undertaking.

Mr. George Dixon, in responding to an invitation to add a few words, said he would deem it a great privilege if he could equal the results which had been achieved by Mr. Wilkinson; to surpass them would be exceedingly difficult.

Upon the proposal of Mr. J. W. Fells, Sir Albert Ball was cordially thanked for attending for the purpose of making the presentation.

MR. C. H. MITCHELL.

The Leeds Corporation Gas Department is to lose its oldest servant through the retirement, after over 50 years' service, of Mr. C. H. Mitchell. Since 1918 he has been Assistant Manager.

It is just over fifty years since Mr. Mitchell started in the Department as an office boy at Meadow Lane works, the undertaking having been taken over by the Corporation about 11 years earlier. Although the whole of his career has been spent in the offices, he has had a good deal to do with the administrative and technical sides of the Undertaking, especially since he became Assistant Manager, to which post he was appointed when Mr. C. S. Shapley became Engineer and Manager.

PRESENTATIONS TO MR. T. F. CANNING.

On Wednesday, Dec. 30, a very pleasing ceremony was performed at the Gas-Works of the Southend-on-Sea and District Gas Company, when Mr. Thomas F. Canning, A.M.Inst.C.E., M.Inst.Gas E., Engineer and Manager, was made the recipient of a very handsome chiming grandfather clock on his retirement from this position (consequent on the amalgamation of the Company with the Gas Light and Coke Company), as a mark of the high esteem and respect in which he was held by the staff and employees in all departments of the Company.

The presentation was made by Mr. R. G. A. Clark, the Assistant Engineer and Manager, on behalf of the staff and employees in all departments; and in making this presentation Mr. Clark referred to the help and kind consideration they had always received from Mr. Canning and how he had spared no effort in his control and guidance to make their task a pleasant one.

In acknowledging the gift, Mr. Canning said that, while he valued it for its intrinsic worth, it also appealed to him as an unsolicited testimonial, because he looked beyond the gift itself and realized that behind it was the genuine expression of good feeling and regard that prompted them to make it. Looking back over the years he had been associated with them at Southend he realized the faithful service and loyal support they had given him at all times. He felt sure they would serve the new Company as faithfully and well as they had served the Southend Company, and he wished them every success and prosperity in the future.

At the conclusion of this ceremony a second presentation was made, on this occasion by Mr. B. F. Allen, Chief Clerk, on behalf of Mr. Canning's personal staff. This presentation took the form of a smoking and spirit cabinet, and, in asking Mr. Canning's acceptance of this reminder of their happy association together, Mr. Allen referred to the good feeling and fellowship which had always existed between them.

In acknowledging this presentation, Mr. Canning expressed his deep gratitude to them for their gift and felt certain that while some Companies might be served by as good and as loyal a staff he was quite certain that there was not one that was served by a better one. He wished them also every success and a prosperous future with the Gas Light and Coke Company.

Presentation from the Board.

On the afternoon of Thursday, Dec. 31, a pleasing ceremony took place at the Gas-Works, when Mr. John H. Burrows, C.A., J.P., the Chairman of the Southend-on-Sea and District Gas Company, in the presence of Mr. H. H. Burrows, Director, and a gathering of the employees, presented Mr. Canning, on behalf of his colleagues on the Board and himself, with the following resolution of the Board, suitably inscribed and framed:

"Southend-on-Sea and District Gas Company."

"Extract from Minutes of Meeting of Board of Directors held on Dec. 23, 1931."

"That this Board records its sense of indebtedness to Mr. Thomas F. Canning, A.M.Inst.C.E., who has served it as Engineer and Manager for more than thirteen years. That period witnessed the Company's greatest progress. Successive balance-sheets issued since his accession to office demonstrate the striking success achieved by the Company; with which progress the Board desire to associate their Engineer, who has been most helpful, efficient, and progressive. The Board feel that he has an established standing in the Gas Industry."

"(Signed) John H. Burrows, Chairman."

In making the presentation Mr. Burrows paid a very high tribute to Mr. Canning and referred to the high esteem and regard in which he was held by his colleagues and himself. He spoke of the marked progress and success of the Company during Mr. Canning's period of office and said it gave him as Chairman great pleasure to make this presentation to Mr. Canning on behalf of his colleagues on the Board and himself with their best wishes for his success and prosperity in the future.

Mr. Canning in acknowledging the gift expressed the deep gratitude he felt at receiving so marked a tribute of the appreciation of the Chairman and Directors of his service with the Company.

OBITUARY

SIR HENRY COWAN.

Sir Henry Cowan, who was for many years a member of Parliament, and Chairman of Messrs. Parkinson & Cowan, Ltd., died suddenly on Jan. 11 at his home at 215, Ashley Gardens, London, from pneumonia following influenza, at the age of 69.

The son of Mr. William Cowan (states "The Times"), William Henry was born in Edinburgh on May 22, 1862, and was educated at Merchiston Castle School, Edinburgh Collegiate School, and Edinburgh University. He became associated with Messrs. Parkinson and W. & B. Cowan, formed in 1900 to take over the gas meter factory in the City established by Mr. W. C. Parkinson in 1862. The style was changed in 1929 to Parkinson & Cowan, and Sir Henry was at his death Chairman of the Company and its subsidiary companies in the manufacture of gas and electricity meters and stoves. Sir Henry was the first Liberal to be elected for the Guildford Division of Surrey, in January, 1906, and sat till 1910, when he was returned for East Aberdeenshire. In 1918 he was elected as a Coalition Liberal, but was defeated in 1922. In December, 1923, having transferred his allegiance to the Unionist Party on the question of tariffs, he was elected for North Islington, and held the seat till May, 1929, when he retired. He had travelled widely and had frequently visited all the Dominions, and his opinion on questions of Imperial trade carried weight. He was knighted in 1917. He was a magistrate for Sussex, where he had a residence at Fairwarp. Sir Henry married in 1900, Winifred, daughter of Mr. Daniel Smith, of Edinburgh, and leaves a son and a daughter.

A "Times" correspondent writes:

Sir Henry Cowan was a man of high purpose and unbounded energy. His life was almost completely absorbed by his business and his politics, and to both he gave himself with enthusiasm, bringing to each a keen realism. Sir Henry had a wide knowledge of the Empire and its economic problems, and with him the cause of Imperial unity has lost an ardent champion and informed adviser. The large business interests with which he was connected were very closely identified with him personally. He took an intense interest in every detail, and was ever more ready to shoulder a fresh burden than to delegate the carrying of it. Certainly he never spared himself, and his death at the comparatively early age of 69 is in large measure attributable to his own high standard of service.

Sir Henry was a man of decided opinions and he never hesitated to press them for fear of the consequences. Compromise was not in his nature, and like all men who are essentially fighters he made his enemies. Nevertheless all will pay tribute to the sincerity with which he held his opinions and the courage and ability with which he urged them. To a smaller circle Sir Henry will be remembered as a man of intensely generous nature and as a very charming gentleman.

SIR GEORGE DAVIES.

A great loss to the Gas Industry and to Bristol's public life has been sustained by the death of Sir George Davies, Chairman of the Bristol Gas Company, who was President of the B.C.G.A. in 1921-22. It was during his term of office as President that the annual conference of the Association was held so successfully in Bristol.

Sir George was Chairman and Managing Director of Campion Davies & Co., wholesale manufacturing confectioners, and was elected President of the Bristol Chamber of Commerce in 1904. In the previous year he had been one of the Bristol delegates at a Congress of the Chambers of Commerce of the Empire held in Montreal. He was chosen one of the Hon. Vice-Presidents in 1911, a compliment he had justly earned. He was a Director of Bristol Water Works Company and a local Director of the Atlas Insurance Company.

In 1902 Sir George Davies entered the Bristol Town Council. He speedily made his mark. When the Education Committee was formed in the following year he was appointed a member, and as Chairman of the Finance Sub-Committee he did work the true significance of which was known only to his colleagues. He was made an alderman in 1913, a compliment honestly earned. During the war he cheerfully accepted other onerous duties, among them being those of Chairman of the National Registration Com-

mittee and Chairman of the local Fuel and Light Committee. In 1918 came a Knighthood as a reward for public services.

MR. F. S. LARKIN.

Another sad announcement to be made is the sudden death at his home last Saturday of Mr. Frederick Stanley Larkin, A.M.I.Mech.E., Manager of the Fulham Stove Works, Harwood Terrace, of the Gas Light and Coke Company. Mr. Larkin was the eldest son of the late Dr. F. G. Larkin, F.R.C.S., L.R.C.P., of 44, Trinity Square, Borough, S.E., and Grove Park. He was born in 1875, and was educated at St. Olave's Grammar School, Southwark, S.E. From 1893 to 1898 he was with Messrs. Wood & Ledward, Agricultural and Condensing Engineers, and he received technical mechanical engineering training under Prof. W. J. Lineham, Goldsmiths' Institute, New Cross. After a short period as draughtsman with the Bryan Donkin Company, of Bermondsey, he was appointed Assistant Mechanical Engineer at the Beckton Works of the Gas Light and Coke Company. In 1902 Mr. Larkin was elected an Associate Member of the Institution of Mechanical Engineers, and in the following year he commenced technical training in Gas Manufacture at the Polytechnic, Regent Street, W., and became a Polytechnic Medallist in Advanced Gas Manufacture. He was appointed Local Manager of the Stove and Meter Works of the Gas Light and Coke Company at Fulham in 1908, and became Manager of the reorganized works in 1929. He was President of the London and Southern District Junior Gas Association in 1929-30. The last we saw of Mr. Larkin was at the Jubilee Dinner of Messrs. William Sugg & Co. a week or two back, when he seemed in the best of health and apparently good for many years to come.

The death took place on Friday, Jan. 8, of Mr. PERCY EDGAR BEAUMONT, of the firm of Messrs. W. G. Beaumont & Son, of Priory Works, Bow, E. 3. The interment will take place at Woodgrange Park Cemetery, Manor Park, E., on Thursday, Jan. 14, at 1.30 p.m., preceded by a Service in the Bromley-by-Bow Parish Church at 12.30 p.m.

The death has occurred of Mr. THOMAS CASH, who was the founder of the Birmingham coal contracting firm of that name. Mr. Cash was known to many in the Industry, particularly in Masonic circles, having been a member of the Evening Star Lodge since 1887, passing through the chair in 1900, and being elected an Hon. Member in 1924. He was, in addition, a member of Murdoch Lodge, of which also he was elected an Hon. Member in 1927.

The death has taken place at Peeblesshire of Mr. GEORGE M'BETH MENZIES, Chairman of Bathgate Gas Company, Ltd. He was 52 years of age.

CORRESPONDENCE

Lessons from the Hawkes Bay Earthquake

SIR,—In regard to Mr. Archibald Dougall's excellent descriptive article on the Hawkes Bay disaster ("JOURNAL" for Dec. 16, p. 723), this to my mind teaches a real lesson, as it did in the big earthquake at San Francisco years ago—namely, that steel-framed buildings seem to be the only type that will stand up to a disaster of this description. In both cases they may have been slightly out of plumb, but were still standing.

Another point he brings out is the usefulness of a water gas plant, as it can be shifted in an emergency like this from one works to another.

MATT. C. LITTLE.

Braeside, Bewdley,
Jan. 9, 1932.

Treatment of Ammoniacal Liquor

SIR,—We note in your issue of Nov. 11, 1931, a reference to a process for the treatment of ammoniacal liquor by stripping with steam and subsequently passing the steam through a producer grate or vertical retort, which process was described by Mr. Prater, of Margate, at the Autumn Meeting of the Institution of Gas Engineers, and which probably corresponds with a patent application in the names of Campbell and Prater dated Aug. 1, 1931. This process appears to be identical with a process we ourselves have developed, for which we applied for a patent on Feb. 11, 1931—*i.e.*, nearly six months prior to the date of the Campbell and Prater application.

In view of the interest shown in this method of utilizing ammoniacal liquor, we shall be prepared to give further information to interested parties, and to grant licences for a nominal fee when the patent is sealed.

For I.C.I. (Fertilizer and Synthetic Products), Ltd.,
G. P. PITTAR,
Secretary.

Billingham,
Stockton-on-Tees,
Jan. 4, 1932.

Dilution of Straight Coal Gas with Producer Gas

SIR,—At the request of Mr. Summerson, of Luton, and with the kind permission of my Chief, I give below relative costs of diluting straight coal gas with producer gas and waste gas at Hertford.

A study of the figures will, I think, clearly indicate the economic value of producer gas as a diluent. Hertford figures do not show a very great saving, coal gas costs being low compared with many other installations of a similar size.

In arriving at the savings to be effected by the use of producer gas, the point to note is that 7·6 therms, of a total 100 therms, have been replaced by producer gas therms costing 1·65d. each, against 3·63d. for coal gas therms, a total saving on 100 therms of 15·0d., or 0·15d. per therm on each coal/producer gas therm.

Naturally the higher the cost of a coal gas therm the greater will be the saving effected by the use of producer gas.

C. A. DEAS,
Assistant Engineer.

Gas Works,
Hertford, Jan. 6, 1932.

Producer/Coal Gas Mixture.

100 *Therms.*

92·4 Therms Coal Gas (650). 7·6 Therms Producer Gas (130).

	£ s. d.
Materials required—	
1·3 tons of coal at 29s. 2d. delivered into hoppers	1 17 11
Wages (carbonizing) at 0·42d. per therm	0 3 3
Maintenance, 92·4 therms at 1d.	0 7 9
" " 7·6 " " " "	
	£2 8 11
Less—	
12·1 cwt. coke at 27s.	0 16 4
2·7 cwt. breeze at 10s.	0 1 4
13 gallons of tar at 2d.	0 2 2
	£0 19 10
Net cost of 100 therms	2 8 11
	0 19 10
	£1 9 1
	d.
Cost Per therm	3·49
Specific gravity of mixture	0·565
P.ct. inerts	21·7
P.ct. CO_2	3·2

Coal/Flue Gas Mixture.

100 *Therms.*

100 Therms Coal Gas (650).

	£ s. d.
1·41 tons of coal at 29s. 2d.	2 1 2
Wages (carbonizing) at 0·42d. per therm	0 3 6
Maintenance, 100 therms at 1d.	0 8 4
	£2 13 0
Less—	
14 cwt. coke at 27s.	0 18 11
2·8 cwt. breeze at 10s.	0 1 5
Tar, 14 gallons at 2d.	0 2 4
	£1 2 8
Net cost of 100 therms	2 13 0
	1 2 8
	£1 10 4
	d.
Cost per therm	3·64
Saving of producer gas dilution method over waste gas method	0·15 per therm
Specific gravity of mixture	0·595
P.ct. inerts	27·6
P.ct. CO_2	5·3

Loss of Calorific Value in Waterless Holders

[In a Diploma Thesis entitled "The Construction of a 5 million c.ft. Waterless Gasholder" which Mr. A. C. Rea, a member of the staff of the Edinburgh Corporation Gas Department, presented at a meeting of the Scottish Junior Gas Association (Eastern District) on Oct. 3, the author stated that there was a loss in the calorific value of the gas stored in a waterless holder of from 5 to 10 B.Th.U. per c.ft. Mr. H. H. Gracie, feeling it incumbent upon him to correct this impression given by Mr. Rea, arranged for two-hourly tests to be taken over a period of 22 days. The object of the experiment was to ascertain whether there was any appreciable loss in the calorific value due to the absorption of hydrocarbons by the tar. The following letter from Mr. Gracie gives the results of his test.—ED. "G.J."]

SIR,—The experiment was started at 6 a.m. on Dec. 2 and continued until 3 p.m. on Dec. 24, 1931. Tests were made every two hours on the inlet and outlet mains of the holder using the same Boys calorimeter, which has been certified by the Gas Referees.

The tests were made consecutively, the outlet being taken a quarter of an hour after the inlet. The service pipes were short and an Argand burner consuming about 15 c.ft. per hour was kept constantly burning to maintain a good stream of gas through the service pipes.

The results show that there is little, if any, variation between the calorific value of the inlet and outlet gases, and generally these are in fairly close agreement both on the shift averages and on the 24-hour averages.

The greatest difference in any one shift was 7 B.Th.U.
" " " " " day " 2·7 "

There does not appear to be any connection between the fluctuations in the calorific value and the barometric pressure and temperature.

The averages of all the two-hourly tests are:

Inlet to holder, 252 tests = 496·04 B.Th.U.
Outlet " , 253 " = 495·55 "

Table I. is compiled on a thermal basis and calculated for every 24 hours. The figures were obtained by the following method:

The calorific values at the beginning and end of the two-hourly periods were averaged, and this multiplied by the volume of gas gave the total therms passed in two hours. The total gas passed in 24 hours was then divided by the total therms for the 24 hours to give the average calorific value.

The greatest difference in any one day is 3·5 B.Th.U., and the total difference is 0·82 B.Th.U. over the whole period.

I think with these figures before you that this bogey of loss in hydrocarbons due to the storage of gas in waterless gasholders can be definitely disposed of.

H. H. GRACIE,
Engineer and Manager.

Edinburgh Corporation Gas Department,
Jan. 4, 1932.

TABLE I.—*Granton Gas-Works.*

WATERLESS HOLDER EXPERIMENTS.

Average Calorific Value at the Inlet and Outlet of Holder for 24 Hours Calculated from the Thermal Input and Output.

24 Hours Ending at 7 a.m.	Inlet.			Outlet.		
	C.Ft.	Total Therms.	Calorific Value.	C.Ft.	Total Therms.	Calorific Value.
4-12-31 . .	11,550	57,598·1	498·68	11,640	58,012·5	498·39
5	11,496	56,880·0	494·78	11,686	58,060·9	496·84
6	11,128	54,789·8	491·46	10,655	52,273·8	490·60
7	11,288	55,709·9	493·53	10,538	52,011·3	493·56
8	10,579	52,391·8	495·24	12,035	59,718·4	496·20
9	11,769	58,023·7	493·02	11,295	55,409·3	490·56
10	12,111	59,794·0	493·72	11,221	55,416·4	493·86
11	11,413	56,596·3	495·89	11,733	58,138·7	495·51
12	9,954	49,297·7	495·26	10,324	50,767·5	491·74
13	10,923	54,637·4	500·21	10,563	52,630·3	498·25
14	10,206	50,752·4	497·28	9,666	48,291·9	499·61
15	11,128	55,840·2	501·80	11,688	58,483·3	500·36
16	11,437	56,576·4	494·67	10,531	51,995·9	493·74
17	10,562	52,245·4	494·65	10,803	53,155·8	492·05
18	9,179	45,996·0	501·10	9,979	49,680·7	497·86
19	11,388	56,522·8	496·34	11,072	54,929·8	496·11
20	11,063	54,913·5	496·38	10,803	53,512·0	495·34
21	10,796	53,604·6	496·52	10,466	51,952·5	496·40
22	10,582	52,296·2	494·20	11,112	54,798·3	493·15
23	10,590	52,190·0	492·82	10,961	54,003·3	492·69
24	10,162	50,515·2	497·10	10,212	50,540·5	494·91
24 (7 a.m.–3 p.m.). .	2,895	14,411·8	497·82	3,814	18,858·5	494·45
Totals . .	232,199	1,151,583·2	495·95 (aver.)	232,797	1,152,641·6	495·13 (aver.)

THE NEWS OF THE WEEK

A Reduction in the Price of Gas in Stockport took effect from Jan. 1, 1932. The old price ranged from 10·67d. to 6·3d. per therm, a discount of 1·3d. per therm being allowed for prompt payment. The new price ranges from 9·33d. to 5·0d. per therm according to consumption, less 2½ p.ct.

The Midland Association of Gas Engineers and Managers are having their Annual Dinner and Dance at the Grand Hotel, Birmingham, on Monday, Feb. 8. Mr. Arthur Roberts, of Hereford (Hon. Secretary), will be glad if members will make early application to him for tickets.

Institution of Gas Engineers.—Copies of the recently issued British Standard Specification for Milling Cutters and Reamers (including Milling Machine Spindle Noses and Arbors) No. 426—1931, which supersedes No. 122—1920, may be obtained, price 2s. each including postage, from the Institution of Gas Engineers, 28, Grosvenor Gardens, London, S.W. 1.

The 4th Annual Children's Party of the Norwich Gas-Works Recreation and Social Club was held on Saturday, Jan. 2, and 235 children of members had a thoroughly enjoyable time, including tea, marionettes, a comedian, Punch and Judy, and a present each on leaving. The club had been suitably decorated with flags, holly, balloons, &c. The members of the Committee and their wives had a busy time both before and during the party, and Mrs. Armitage, wife of the Club President (Mr. C. Rhodes Armitage), distributed the children's presents. The Club is as active as ever, and is highly esteemed in the City, all forms of indoor and outdoor sports being catered for while weekly concerts and whist drives are well patronized.

Bradford Gas Committee, on Jan. 8, decided to seek power to borrow £50,000—£10,000 for steel mains and £40,000 for cast-iron mains. The last application was in 1926, also for £50,000.

Gas-Works Model Competition.

The opinion has been expressed from a number of quarters that it is desirable to permit collaboration in the preparation of the model and essay.

Messrs. Newton, Chambers & Co., Ltd., and Mr. Evetts, who is judging, feel that the object of the competition would be very fully accomplished if there were collaboration on these lines, and it was never their intention to rule out joint efforts. It has also been decided to agree to the extension of the time for entries to Tuesday, Feb. 16 next.

There are a few sets of the model still available.

The Throgmorton Avenue Explosions.

Jury's Finding at Inquiry.

[From "The Times" of Jan. 9.]

The explosions in Throgmorton Avenue on Dec. 30, in which sections of the roadway were torn up and manhole covers blown into the air, were the subject of an inquiry at the City Coroner's Court on Jan. 8 by Dr. DANFORD THOMAS, the Deputy City Coroner, and a jury. Mr. C. T. HALLAM represented the G.P.O., Mr. DOUGLAS GARRETT the

THE NEWS—*continued.*

Gas Light and Coke Company, and Mr. L. P. ARNOLD the Metropolitan Water Board.

Mr. *H. A. Smith*, sectional engineer in charge of the external works of the Post Office, London District Telegraph and Telephones, produced a safety lamp used for carrying out the inspection in Throgmorton Avenue a few hours before the explosion occurred. He said that if sewer gases came in contact with the lamp the flame became dim and eventually went out. If the men suspected coal gas their instructions were to take all precautions and to take the covers off all the inspection boxes. He had never known coal gas to become ignited by the flame in the safety lamps used by G.P.O. employees.

Frederick Fisher, a telephone linesman, employed by the G.P.O., said that while inspecting a box in Throgmorton Avenue on Dec. 30 he detected a smell of what he thought was sewer gas. He then heard a puff from the gulley and saw flames. A few minutes later the explosions occurred.

Arthur Henry Wright, a labourer, employed by the G.P.O., said that while they had one of the boxes open he noticed a man who was passing by strike a match and light a cigarette.

Mr. HALLAM: Did any of you use a naked light?—No. And were any of you smoking?—No.

Mr. *G. H. Rodgers*, divisional mains superintendent, employed by the Gas Light and Coke Company, said that when the gas main was stripped it was found to have been recently fractured. In his opinion this was caused by a subsidence of soil around the main. Except for this fracture the main was perfectly sound. If sewer gas had exploded it might have caused the fracture.

Mr. HALLAM: Can you tell us when this pipe was laid?—I think it was in 1881.

The jury found that the fire was caused by a gas explosion due to a naked light igniting an escape of gas. They also found that every reasonable precaution was taken by every one concerned.

The CORONER recorded a verdict accordingly.

Brownhills Gas Bill Rejected.

The result of the poll of local government electors which was taken at Brownhills on Jan. 4 to decide whether or not they were in favour of the promotion by the Urban District Council of a Bill to acquire the undertaking of the Ogley Hay and Brownhills Gas Company, and for other purposes, was declared on Tuesday as follows:

For	914
Against	1273
Majority against	359

Only about one quarter of the total electorate recorded votes.

The town's meeting which was held about a fortnight ago (see "JOURNAL" for Dec. 23, p. 776) also gave an adverse vote by 102 to 67. A poll was then decided upon by the District Council, and as a result the Bill could be definitely regarded as being "dead."

About a year ago the Cannock and Hednesford Gas Company obtained from the Board of Trade a Provisional Order authorizing them to absorb the Brownhills Company, but this was made subject to any powers which Brownhills Urban District Council might obtain.

As a result of the vote now given by the electorate it is likely that the Cannock Company's Order will now take effect without any condition being attached to it.

The Brownhills Company has an authorized capital of £24,745 and has issued £9000 (including premium) in ordinary shares and £5745 in preference shares.

Institute of Fuel.

Presentation of the Melchett Medal and Melchett Lecture.

The Melchett Medal for the year 1931 (the second to be awarded) will be presented to William A. Bone, F.R.S., of the Imperial College of Science and Technology, South Kensington, by the President (Sir Hugo Hirst, Bt.), at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C. 2, on Monday evening, Feb. 1, at 6.30 p.m.

The Melchett Medal was instituted by the Founder-President, the first Baron Melchett of Landford, who offered the Institute a sum of money sufficient to found the Medal in perpetuity. The Medal is awarded annually, and the Council, in making the award, were guided by the conditions laid down by the Founder.

Following the presentation, Prof. Bone will give the Melchett Lecture, his subject being "A Century of Fuel Economy."

Immediately following the meeting, Prof. Bone will be the guest of the Institute at a dinner to be held at the Connaught Rooms, Great Queen Street, Kingsway, W.C. 2.

Those members and friends (ladies and gentlemen) who desire to honour the Melchett Medallist by being present at this dinner can obtain tickets (price 12s., exclusive of wines) on application to the Secretary, the Institute of Fuel, 53, Victoria Street, London, S.W. 1. Evening dress will be worn by those attending the dinner.

Members of all Scientific and Technical Societies are cordially invited to attend the Presentation and Lecture, for which no tickets of admission will be required.

Gas in Wolverhampton.

The Wolverhampton Gas Company, stated a recent issue of the "Financial Times" in its "Potential Investments" column, was established in 1820, amalgamated with the Wolverhampton New Gas Company in 1847, and incorporated by special Act in 1852. The statutory area of supply includes the county borough of Wolverhampton and some half-a-dozen adjoining districts.

The standard price of gas is 12·8d. per therm and successive reductions have been made until at the close of 1930 it was 8·88d. Consolidated ordinary dividends are subject to the usual sliding scale. The number of consumers and the sale of all types of appliances have continued to record steady increases. The standard consolidated ordinary stocks have been converted, further capital raised, and additional general powers authorized.

Presentation of Prizes at Cardiff.

On Wednesday last Mr. H. D. Madden, Mr. R. J. Auckland, and Mr. B. J. Bell met the gasfitters of the Cardiff Gas Light and Coke Company, and Mr. Madden presented 27 prizes in "kind."

The occasion was the outcome of a scheme formulated for seeking the fitters' co-operation as salesmen on the district, where they have such wonderful opportunities with the consumers to obtain orders for new apparatus.

The Board of Directors of the Company offered a series of prizes for the best returns, and for the foreman in charge of the district which obtained the best results. The period covered was six months, and results proved unexpectedly successful, and showed the value of co-operation in promoting sales of appliances and assisting the sales activity of the Company. The second six-monthly period is now on, and there are greater enthusiasm and competition between the district groups of fitters to obtain the best results.

The prizes, as stated, were given in "kind," and a large number selected special tools, technical books, were distributed.

Nottingham's Reduced Prices.

The question of a reduction in the prices charged for gas at Nottingham was again under the consideration of the City Council at its meeting on Monday, the 4th inst., when it was determined, in accordance with the recommendation of the Committee, to lower the rates charged as from the September quarter by 1½d. per 1000 c.ft. to ordinary consumers and by 2d. in the case of prepayment consumers. A suggestion as to the abolition of meter rents, for which there has been long a demand locally, had been negatived at a previous assembly upon the ground of substantial loss of revenue which it would entail at a time when financial considerations did not warrant the change. There was some opposition to the report upon the ground that still further reductions ought to be made.

Forthcoming Engagements.

Jan. 16.—YORKSHIRE JUNIOR ASSOCIATION.—Meeting in Leeds.

Jan. 20.—B.C.G.A.—Executive Committee Meeting, 11 a.m.

Jan. 20.—B.C.G.A.—General Committee Meeting, 2.30 p.m.

Jan. 21.—S.B.G.I. Council Meeting in the afternoon.

Jan. 23.—SCOTTISH JUNIOR ASSOCIATION (WESTERN DISTRICT).—Visit to Johnstone Gas-Works.

Jan. 27.—SOUTHERN ASSOCIATION (EASTERN DISTRICT).—Meeting at 28, Grosvenor Gardens, at 2.30 p.m.

Jan. 29.—LONDON AND SOUTHERN DISTRICT JUNIOR ASSOCIATION.—Meeting in London. Paper by Mr. Roy Summerson, "Exhausting and Governing Gas from Retorts."

Feb. 6.—MANCHESTER AND DISTRICT JUNIOR ASSOCIATION.—Visit to new works at Lostock Road, Preston. Paper on "Industrial Gas Furnaces" by Mr. G. H. Windiate, of Stretford.

Feb. 8.—MIDLAND ASSOCIATION.—Annual Dinner and Dance, Grand Hotel, Birmingham, 6.30.

Colour Up-to-Date.

There is no time of the year when the home is so appreciated as the December and January months when hospitality is at its most genial height.

Comfort, beauty, and service are the things that every householder and hostess aims at in the home. The new issue of "Decoration," published by A. G. Reynolds & Co., Ltd., of 34, Duke Street, St. James's, S.W. 1, gives ideas for these in a production that distinguishes it from other home periodicals. Beauty in the new decorative tinted sheet glass, comfort in the space saving service of built-in and built-up furniture, service in detailed practical advice by an architect on planning for warmth, light, and domestic labour saving are but a few of the illustrated articles in the letterpress.

An outstanding cover in black, red, and green with the silver fleur-de-lys that has become the very signature of "Decoration" marks the first birthday number. In spite of the depression this magazine has now flourished for a year making an ever-increasing army of new friends.

The photogravure of international art maintains its usual high standard, and the eight-page colour photography section of modern interiors is presented in a new guise, the pages being mounted.

Gas Under Pre-War Price.

Councillor J. Neill (Chairman of the Bangor Gas Committee) entertained his colleagues of the Bangor Borough Council Gas Committee and a number of officials to supper in the Gas Offices last week. At the inception of the gas undertaking in 1883, he said, there were 121 consumers and at present the number was 4748. The present price of gas at 3s. 2d. per 1000 c.ft. was the second cheapest in Ireland, and was 2d. under the pre-war price. Instead of contributing to the rates from profits, they preferred to give the consumer the advantage of cheaper gas. He paid tribute to Mr. B. Mitchell, Manager, who had given 31 years' service to the undertaking, and to the other officials associated with him.

Sixty-Three Years at 6 P.Ct.

Sunderland Company's Record.

Commenting upon the sound financial position of the Sunderland Gas Company, the "Financial Times," in a recent "Potential Investment" column, mentioned that the Company was incorporated by Special Act in 1857, and its statutory area of supply covers some 36 square miles, including Sunderland, Monkwearmouth, Southwick, Whitburn, Castletown, Ford, Ryhope, and Silksworth. The undertaking is administered with commendable enterprise, notably in the direction of advertising and promoting the sales of bye-products.

The 6 p.ct. maximum dividend requires £17,972. Dividends are not subject to a sliding scale. The maximum price of gas is 9·6d. per therm, and several reductions have been made, bringing the figure down to 6d., a rate which is among the lowest throughout the country.

The authorized capital stock is £360,000 in the form of 6 p.ct. maximum ordinary stock, of which £299,542 is issued and paid, including £86,442 added on conversion in 1920. Premiums amount to £47,928. Distributions at the full rate have been made each half-year since 1869. At about 97, the stock returns a yield of 6⅛ p.ct.

Borrowing powers are equal to one-half the paid-up capital stock, but have not been exercised.

Claim for New Smokeless Fuels.

Mr. S. Moore, Managing Director of Catherall's Brickyard, Buckley, and a member of the Hoylake and District Urban District Council, claims to have invented a means whereby he can produce (1) smokeless coal of better quality than that now in general household use, and at no greater cost to the purchaser; (2) petrol at about half the present cost per gallon; (3) coal gas of rich quality at a price below that now obtaining in many places.

Arrangements, we understand, are in hand for the formation of a private company to put down a plant to treat 500 tons of slack weekly, and this will cost about £50,000. It will be installed at Messrs. Catherall's works, which are in close proximity to the Wrexham coalfield, and form a good centre for the distribution of smokeless coal. Tests of slack from the various coalfields in the Wrexham district have been made.

THE NEWS—continued.

Joint Gas Conference at the B.I.F.

A Joint Conference of the Institution of Gas Engineers, the Society of British Gas Industries, the British Commercial Gas Association, and the National Gas Council will be held on Tuesday, Wednesday, and Thursday, March 1, 2, and 3, at the British Industries Fair, Castle Bromwich, Birmingham.

Members wishing to attend are strongly advised to apply immediately for accommodation to the Accommodation Department of the British Industries Fair, Chamber of Commerce, New Street, Birmingham, stating what accommodation is required and whether a Boarding House would be acceptable if hotel accommodation cannot be secured. Accommodation will be very limited and it is most important that immediate application should be made. Free admission tickets to the Fair and railway vouchers at reduced rates will be available.

The following preliminary programme has been arranged for the Conference, of which Mr. H. C. Smith is again Hon. Secretary:

Tuesday, March 1, 1932.

10 15 a.m.	Assemble at Conference Hall, British Industries Fair, Castle Bromwich.
	Opening of Conference.
11. 0 a.m.	Presidential Address by Sir Arthur Duckham, G.B.E., K.C.B., M.Inst.C.E., M.Inst.Gas E.
1. 0 p.m.	Official Luncheon at the British Industries Fair (delegates paying for their own luncheon).
Afternoon.	Inspection of exhibits at the Fair.

Wednesday, March 2, 1932.

10.15 a.m.	Assemble at Conference Hall, British Industries Fair.
10.30 a.m.	Address by Dr. J. S. Haldane, C.H., F.R.S., on "Underground Gases."
	Discussion.
1. 0 p.m.	Luncheon at British Industries Fair by invitation of the Birmingham Chamber of Commerce and the Fair Management Committee.
Afternoon.	Inspection of exhibits at the Fair.

Thursday, March 3, 1932.

10.15 a.m.	Assemble at Conference Hall, British Industries Fair, where a description will be given to members of the exhibits in the Gas Industries Section and also of exhibits of special interest to the Gas Industry outside the Gas Industries Section.
10.30 a.m.	Official inspection of exhibits.
	No special arrangements are being made for Luncheon.

North Middlesex Gas Company.

The North Middlesex Gas Company, stated the "Financial Times" in a recent "Potential Investments" column, was established in 1862 and incorporated by Special Act in 1895. Its statutory area of supply covers nearly 11 square miles, including East End and Church End, Finchley, and parts of North Finchley, Hendon, Mill Hill, and Golders Green.

In these districts the provision of additional transport facilities has greatly stimulated building operations, both for residential and industrial purposes, and, as a result, the services of the public utility undertakings have rapidly increased year by year.

In spite of successive reductions in the price of gas, from 12d. in 1926 to 9·4d. in 1930, revenue has advanced substantially and enabled stockholders to reap the benefit of the sliding scale governing the dividend.

The total capital authorized is £425,250, of which there was issued and paid up at Dec. 31, 1930, £360,646, including £25,250 added on conversion on Jan. 1, 1927, and £40,706 premiums, leaving £64,604 to be issued, of which not more than £45,000 is to be issued as preference stock. Borrowing powers are one-half the paid-up capital, the total amount exercised and outstanding being £168,700.

In respect of the year just closed the usual half-year's dividend of 3¾ p.ct. was paid.

Water Chandelier Tragedy in Plymouth.

Another illustration of the danger of the old-fashioned water chandelier gas fitting is provided by a tragedy which occurred on New Year's Day at Plymouth. Miss Emily Kate Hawking, aged sixty-one, was found dead in a gas-filled room at her home, 4, Stopford Place, Stoke, where she had lived for fifty-six years.

At the inquest on Monday, Jan. 4, a tenant in the house said that on Dec. 29 her husband and herself complained to Miss Hawking about the noises which came from the chandelier in the front room, and Miss Hawking promised to have it attended to and apparently ordered a plumber

THE NEWS—*continued.*

to do the work, but he did not come until the day after the tragedy had occurred.

Hedley Charles Pearn, a fitter employed by the Gas Department of the Plymouth Corporation, told the Coroner that he examined the chandelier after the fatality and found that it contained no water. It was in a similar condition when he visited the house more than a year ago to inspect fittings, and he condemned it as obsolete on that occasion.

In recording a verdict of "Accidental Death from Gas Poisoning," the Coroner said there was no doubt that if Miss Hawking had had the repairs done before she would probably have been still alive. "It is of the utmost importance," he continued, "that people who still retain these water chandeliers should realize the danger of them, and discard them as soon as possible and have more modern fittings."

Health Exhibition, Brighton.

The Health Exhibition of the Royal Sanitary Institute will be held at Brighton from July 11 to 16, 1932. This Exhibition is arranged in connection with the Annual Congress of the Institute, which is attended by representatives of Government Departments and Municipal Authorities throughout the United Kingdom, and also from many places abroad and in the Dominions. Members of the various trades and professions interested in the exhibits and the general public are admitted to the Exhibition.

Health and hygiene will be represented in every aspect, including lighting and heating. We understand that a great deal of the space has already been taken up, and would advise intending exhibitors to make early application for the remaining positions. The address of the Secretary of the Institute is 90, Buckingham Palace Road, London, S.W. 1.

A Few of the Exhibits at the Physical and Optical Societies' Exhibition.

The Twenty-Second Annual Exhibition of scientific instruments and apparatus, promoted by the Physical Society and the Optical Society, was held at the Imperial College of Science and Technology, South Kensington, S.W., from Jan. 5 to Jan. 7 last. Among the exhibits of more direct interest to the Gas Industry mention may be made of the following:

A new carbon dioxide measuring apparatus, fitted with independent indicator and recorder, was being demonstrated by the Cambridge Instrument Company, Ltd., of London. Incorporated in a standard Cambridge measuring unit is a bridge system in which only one unit operates both a recording and an indicating instrument, or two indicating or two recording instruments. Both the indicator and the recorder can be in continuous operation without any need for switching out the recorder when taking an indicator reading. Either of the instruments may be removed from the circuit independently. The same firm were also showing a dew point recorder for flue gases.

Messrs. A. Gallenkamp & Co., Ltd., of London, showed for the first time a portable gas analysis apparatus, a new and most compact instrument for analyzing flue gases, &c., in addition to ordinary laboratory routine analysis. Messrs. Muirhead & Co., of Beckenham, showed their standard Muirhead-Ranarex indicator and recorder. This instrument gives a continuous record of the carbon dioxide percentage in a gas. Messrs. Elliott Brothers, Ltd., London, demonstrated electrical gas analysis apparatus.

A new design of gas indicator had a prominent position on the stand of Messrs. Griffin & Tatlock, of London, which was developed in the first instance by the Admiralty Research Department. This instrument, in a slightly modified form, has numerous applications, among which may be mentioned the whole field of petrol distribution, storage and refining, the recovery of solvent vapours in various industrial processes, such as benzene, &c., and also in connection with all gas scrubbing processes for determining the efficiency of recovery or removal of benzole in coal gas and coke oven gas.

Messrs. George Kent, Ltd., of Luton, were exhibiting pressure, flow and level controllers, and also various kinds of temperature controllers and apparatus for measuring and controlling the rate of flow of fluids. There was also on view on this stand a new combustion efficiency meter enabling very close control to be arranged for the supply of air to furnaces. The Foster Instrument Company, of Letchworth, displayed several new types of surface or contact thermometer and pyrometer, and the Drayton Regulator and Instrument Company, Ltd., of West Drayton, displayed various well-known products, including the Drayton cycle recorder regulator for temperatures.

Messrs. Short & Mason, Ltd., of Walthamstow, were demonstrating a number of useful gas leakage indicators, their design being based on the principle of the diffusion of gases. These instruments indicate instantaneously any gas pressure. The same firm gave also a selection of other gas recording and indicating gauges and various automatic time and temperature control regulators.

The Thermal Syndicate, Ltd., of Wallsend-on-Tyne, were exhibiting a water operated gas ejector pump, and, among other products, specimens of their well-known "Vitreosil" heat proof lighting ware, reference to which has been made in the "JOURNAL" on a number of occasions. Messrs. G. Cussons, Ltd., Manchester, showed the most recent types of "Scholes" bomb calorimeter, including the standard outfit for research or ordinary practical purposes, and also a simpler set for educational use.

Notes from Scotland.

A Proposal Has Been Made to supply the village of Garelochhead with gas from Helensburgh.

Kirkcudbright Town Council has remitted to a Committee for consideration a proposal to acquire showrooms.

NOTES ON PLANT AND PROCESSES

British Tubes.

In support of the present "Buy British" campaign, the Wellington Tube Works, Ltd., of Great Bridge, Tipton, Staffs., have produced a new and enlarged version of the catalogue and handbook, which, published three years ago, proved so successful and was in such demand.

Throughout the last ten years the makers of Wellington tubes and fittings have aimed at producing work of the finest quality and at selling it at the lowest price of which this quality would allow.

It is fitting that in a publication dedicated to the support of the "Buy British" campaign, the opening section should be devoted to the Prince of Wales' visit of inspection to the Company's works on May 11, 1931 (mentioned in the "JOURNAL" for May 20 last), at the time when His Royal Highness took upon himself to act as "liaison officer" between the Chambers of Commerce, as representing British industry, and our overseas markets. The first of several important works which he visited in the Midlands was the Wellington Tube Works, and he was intensely interested in witnessing the manufacture of tubes through all the operations to the finished product.

The catalogue goes on to describe the evolution of the tube from Roman times up to the vast organizations of today such as the Wellington Tube Company producing tested and standard tubes of widely varying sizes. Tubes, it is stated, have been jocularly described as "holes of various sizes surrounded by metal," and to the ordinary man the word means anything from the Tube railway tunnels to the small gas pipes in his household; to the scientist the range descends in size until a tube with almost microscopical bore is reached. Probably only engineers realize that tubes in some form or another are essential to the comfort, progress, and very existence of modern civilization.

The works of the Wellington Tube Company were established by Mr. Joseph Aird in the year 1872, his object being to attain a very high standard of tube manufacture to meet the constant problems set by inventors and engineers; and the next section of the publication describes the range of the Company's products for gas, water, and steam requirements, a number of excellent photographs showing several of the manufacturing processes in operation. Illustrations and specifications of the firm's products are given, while methods of testing are also described. The specification of the Institution of Gas Engineers, in accordance with which the tubes are produced, is set out, while the various joints, fittings, and accessories manufactured are dealt with.

As a whole this catalogue forms a very complete and practical work of reference for a wide range of tube requirements, both wrought iron and mild steel, at the same time making very interesting and instructive reading, and giving an insight into the great care taken by the Company in the production of the finished article.

THE PRESERVATION OF FOOD

In which a Vital Domestic Problem is Discussed

In the issue of the " JOURNAL *" for Dec. 16 there was published a letter from Mr. T. P. Bennett (who is an architect) on the subject of refrigeration, and in it he made the suggestion that it would be an advantage if opinions could be obtained on food preservation from eminent authorities of medicine and hygiene. A paper was read in 1928 by Mrs. M. A. Cloudesley Brereton before the Congress of the Royal Sanitary Institute, one section of which dealt with this topic; and as that paper is now entirely out of print, we have her permission to reproduce the following portion of it.*

The part we are desirous of quoting opens with a paragraph in these terms, taken by Mrs. Cloudesley Brereton from the report of the Departmental Committee upon whose findings regulations were made prohibiting the use of preservatives in food (except in certain articles specified):

"There is in this country a lack of facilities for refrigeration and of cold storage generally. This applies less to the provision of large cold storage warehouses for the wholesale trade than to the use of cold chambers in the larger retail stores and cold safes in small shops. In the United States of America, for example, where the use of preservatives is very restricted, the provision of these facilities is the rule. In this country it is only within recent years that methods of refrigeration have been introduced among retailers, and even now they are more usually found among purveyors of meat than elsewhere. There are indications, however, that the use of refrigeration is extending, and the columns of the various food journals bear witness to the fact that many firms are catering for the provision of refrigerating plant in the various branches of food industry. We are strongly of opinion that the further extension and more general use of this method of preserving foodstuffs until they are sold will in the natural course of events minimize the use of preservatives."

A Problem Implied but Unapproached.

That is the Committee's statement in Section 166 of their Report. You will notice the qualification in the last sentence contained in the words "until they are sold." I propose to deal with this point presently, when I come to actual prevailing conditions for food storage in the home, but in the meantime I would remind you that the Committee were concerned strictly with an examination of the desirability or otherwise of permitting the use of preservatives in food, taking into consideration any possible commercial difficulties. They were not concerned with discussing the innumerable ways and means which exist for preserving food for short or long periods on a small or a large scale in the home. For one thing it may justly be said from an official point of view—and it often is said—that the storage of food for more than a short period in the home can be avoided, however inconvenient it may be to do so. For another thing the problem—and from an unofficial point of view there *is* a problem, whether or not the solution of it is affected by the absence of chemical preservatives—varies indefinitely according to the size, situation, and circumstances of the house and household. The Committee were concerned solely with safeguarding the public. To expect more would be like asking a man who has just saved you from drowning to teach you how to swim.

We do, however, find the Committee calling upon traders *and consumers* to "recognize that they are dealing with delicate and easily deteriorating substances," and at the same time they issue a warning against "the careless and unnecessary exposure of perishable foods to quite unsuitable temperatures." Now why do they attach so much importance to this matter of cool storage?

They do so because it is an accepted fact that whenever the temperature rises above 50° Fahr., food begins to spoil many times faster than at any lower temperature; and the temperature does in fact rise above 50° Fahr. on more than 300 days in every year.

Practical Marketing and Cool Storage.

How can these conditions best be met by the consumer? Let me first of all quote an extract from an article in the December, 1926, issue of "Welfare Work," the Journal of the Institute of Industrial Welfare Workers, by Dr. Ruth Procter, Head of the Department of Hygiene and Bacteriology, King's College for Women. "It is a cardinal rule," she writes, "but one which is frequently neglected, that as far as is consistent with economy and the exigencies of transport, supplies should be ordered for short periods so that they may be frequently renewed. In this connection it will generally be found in London that large firms will be willing to undertake a contract for a weekly delivery of stores at no increase of price. It is, on the other hand, quite impossible to avoid some storage of food, particularly in cases where the amount of food to be consumed each day can be estimated only approximately.

"A consideration of the conditions most favourable to the growth of the organisms of decay," goes on Dr. Procter, "will give a great deal of help in determining the best storage arrangements. All these organisms flourish best in a warm moist atmosphere, so that the first essential is to secure storage room that is both cool and dry. In general a north aspect with free ventilation and adequate protection from the weather will help to secure this. . . . Meat, milk and milk products, margarine, vegetables and eggs are attacked chiefly by bacteria" (as opposed to moulds, which attack dry foods), "and cold storage is undoubtedly the best safeguard against all bacterial activity, as this ceases somewhere between 0° C. and 10° C."

Dr. Procter is by no means alone in maintaining that dryness is of vital importance in preserving food. We know that even in a cold atmosphere the presence of humidity will encourage the growth of bacteria in spite of low temperature, and I need hardly say that ours is essentially a humid climate—especially in the winter, when, moreover, the artificial heat of kitchen quarters is as much a menace to food storage as the heat of summer.

Limitations of the Average Larder.

To come back to the question of storage; assuming that even small quantities of food have to be kept indefinitely in the home, where and how is the requisite cool dry atmosphere to be obtained?

Well, there is, or ought to be, the larder. We have it stated in a "Housing Manual" issued by the Ministry of Health that "the larder is an essential. It should be on the north side or be carefully shielded from the hot sun. Good light and ample ventilation to an outside area which is free from risk of contamination are important. The size depends on other provision of storage space in the dwelling and on its location in relation to shops or market. Generally, more space should be provided in rural areas and particularly where there is a large garden and no barn accommodation for its produce."

"A dark cupboard, even if ventilated to the open air, is very unsatisfactory for the purpose, though sometimes in re-conditioning old houses nothing better may be practicable."

Let me amplify the conditions laid down by the Ministry of Health with a few extracts from a section on larders in an excellent little booklet on "Architecture and Home Organization" issued by the Association of Teachers of Domestic Subjects—a body, by the way, which has done the most valuable pioneer work in raising the standards of domestic science teaching and practice.

The function of the larder, as set out in this booklet, is "to contain all the perishable food, and to preserve it as long as possible free from contamination. It should therefore be well ventilated yet free from flies, cool yet not damp, with non-absorbent surfaces to its shelves and walls, so that they may be easily scrubbed. Ventilation may be through several air-bricks protected from flies by gauze wire, and placed so that cross ventilation and a circulation of air from floor to ceiling will take place. The position of the larder is preferably against a north and east wall, so that it is cool, and cross ventilation is possible. It should open from the scullery to be convenient for getting food in and out. The shelves may be made of slate, or some other non-absorbent material, and should not touch the wall at

the back, as this will entail corners to clean, and prevent the free circulation of air. Walls and floor are best made of tiles, as these are easy to wash satisfactorily. The door should fit so as to be fly and draught proof. It should be placed in the long side of the larder cupboard so as to show everything within at a glance."

Now how many larders to-day fulfil even the more essential of these conditions? There are a hundred so-called "practical considerations" to combat the literal interpretation of such requirements; and the speculative builder, at least, is scarcely likely to advertise up-to-date space-saving kitchen quarters with one hand and construct an ideal larder with the other. I am not blaming the builders, but modern conditions, above all in towns, where people are more and more deserting houses for flats and maisonettes. There might, in the ideal flat, be room for the ideal larder, for after all the larder need not be large, if it is well-placed and well designed. But our flats are not ideal; they are more often than not converted floors of houses.

The Need Met: Home Refrigeration.

In the prevailing circumstances—circumstances which, for economic reasons, are likely to prevail indefinitely—is there not a solution to be found in the increased use of refrigeration? Let it be understood that refrigeration, in domestic use, does not imply the *freezing* of foodstuffs; it must be looked upon as the provision of a *cold* larder, and I think it can be shown that the refrigerator will in many instances be the cold larder of the future.

It is not my province to specify in any detail the several machines for household refrigeration which are now upon the market, but I must at least describe in general terms the main divisions in which they may be classed.

The simplest form of refrigerator is one in which the walls are made of perforated zinc, and the temperature is lowered by the evaporation of water on cloths which are fastened tightly round the walls and absorb their moisture from a surrounding trough.

A common form of refrigerator of a more elaborate kind involves the use of a large block of ice in a chamber adjacent to the food storage box. The walls have to be non-conducting, and drainage must be arranged. Then, on a rather luxurious plane, there are refrigerators which are run by power from an electric motor.

Lastly there is a simple automatic refrigerator, operated by a system of evaporation and condensation, which has no motor, but depends for its action on the application of heat, by gas or electricity, to the point where evaporation is effected.

Examples of the several types of refrigerator may be seen and demonstrated daily at the Institute of Hygiene, 28, Portland Place, London.

Now any type of refrigerator has this advantage; that it can be placed at the will of the householder wherever it is most convenient, without constructional work. If one of those is to be installed which depend on their connection with the gas or the electricity supply, it can be fixed in a very short time in any position required. That, and the fact that these models can be obtained now on hire purchase terms over a long period, are my reasons for thinking that there is definitely a future for the refrigerator as the means of providing domestic cool storage.

It is not unreasonable to suggest that refrigerators, especially of the inexpensive and economical motorless type, may easily repay their capital cost in course of time in the economies they effect, and although I make no attempt to advocate their use as a domestic necessity, I do feel that they have a claim to consideration as perfect alternatives to the unapproachably ideal larder. I can say with conviction that these refrigerators are increasingly being installed by builders of modern flats and houses, and that there is a growing demand for them by private householders.

Refrigeration Adopted by Retailers.

While I look for an extension of the use of refrigerators in the homes of the future, I can see definite signs of their adoption by the retailer—large or small.

It is evident from what is everywhere going on that the trader will be convinced by the practical commercial advantages of refrigeration, and that he will not be obliged to steel himself to philanthropic action.

I can quote one typical example—that of a firm controlling a large chain of stores all over the United Kingdom. Before refrigeration was available there was the greatest difficulty in each depôt in finding the coolest spot to keep food overnight or during the week-end. This spot was usually on the floor in some corner where there was a draught. It may be supposed that this was scarcely hygienic. Even then there was a great risk of spoiling. Now, when each depôt has its refrigerator, the actual saving in money, from the sale of foodstuffs which previously would have gone bad, is considerable. It is worth remembering that the average shop temperature, as early in the year as May, is 62° Fahr., and the temperature in an efficient refrigerating cabinet is normally about 35° Fahr.

In so far as I may seem to be exceeding the scope of my subject, I would say this. It is every housewife's duty so to conduct her marketing that she will make the retailer understand the situation brought about by the new Regulations, and respond to it. Her's, indeed, is a two-fold responsibility; first to insist that the food which she buys is fresh and wholesome at the time of buying, and secondly to store it herself with the strictest regard to those hygienic conditions which are *expected* of the larder and definitely *obtained*, without anxiety, by the refrigerator.

Gas Industry Stages Display - - at Charing Cross - -

An exhibition arranged by the Gas Light and Coke Company on behalf of the whole Gas Industry

Those familiar with the district will know that for some time past now the west end of the circulating area of Charing Cross Underground station, on the Embankment, has been devoted to displays by various British industries; and during the fortnight which commenced on Jan. 7 a most interesting and comprehensive display has been arranged by the Gas Light and Coke Company on behalf of the whole Gas Industry.

This is undoubtedly a very valuable site for such displays, for throughout almost the whole twenty-four hours of the day there is a constant stream of people passing within a few feet of the exhibits, while during the business "rush hours" the number is augmented to an enormous extent. And with trains so frequent as they are at this station none grudges a few minutes to look round an exhibition, which is not only free, but, in addition, is of such obvious personal interest to the average business man or woman as a domestic gas appliance display.

Demonstrations.

The exhibits are arranged in semi-circular formation in separate, large glass cases, all the appliances being clearly numbered and named. The side facing outwards into the circulating area is arranged for demonstration purposes throughout the day—the first three days being devoted to gas mantle making; the next three days to the manufacture of meters; the next three days to demonstrations explaining how the gas thermostat operates; while on the concluding three days of the exhibition the correct handling of the modern gas cooker will be demonstrated.

During intervals in these demonstrations a small cinema screen at the rear shows interesting films dealing with gas and bye-product manufacture, &c.

The general colour scheme of the exhibit is attractive, being in red, lined with gold, while the lighting is excellent, consisting of modern panel pendent fittings, the distance control mechanism of which the public are invited to test and operate.

The Exhibits.

Among the up-to-date gas appliances displayed in the various sections are the following: Laundry section—Gas wash-boiler, iron, and clothes-drying cabinet; water heating section—A range of gas storage heaters, including the "Sunhot," in two sizes, "Equator," and "Ruud." Examples of the "Indusa" heater are shown, together with attractive types of gas fires, such as the "Panella" inset model and the "Marlborough" in stainless steel finish with surrounds to match. For hotel uses a Davis hot closet and carving table is shown, while corresponding with

this on the other side of the centre piece is an assaying furnace. The centre piece is a most fascinating perspective model of "The Largest Gas-Works in the World"—Beckton, while below are set out a few of the many products emanating therefrom. The model, besides clearly showing the gasholders, retort houses, purifiers, &c., goes into considerable detail, even down to the river-side wharfs, coal unloading apparatus, railway system, complete with trains, and so forth.

The cooking section contains "Challenge," "Mainservor," and "Bungalow" New World appliances. In addition there is a small gas-operated refrigerator and an automatically controlled central heating boiler, in conjunction with appropriate column and wall type radiators in gilt finish, the installation being complete with an example of the remote control thermostat. A number of smaller appliances complete the display, these including attractive lighting globes and fittings, "Raybol" heaters, gas screen heaters, gas poker, soldering iron, curling iron, and "Reflector-Ray" pedestal bowl heater. Behind the exhibits are appropriate panels and slogans, with interesting information concerning the Gas Industry.

An Undoubted Success.

A cabinet of excellent photographs shows examples of gas apparatus for all purposes, domestic, commercial, and industrial, each being clearly explained. Interesting and appropriate literature, together with inquiry cards, are available for any to take away, and we understand that a number of inquiries have already materialized as a result of the exhibition.

Entering the station either from Villiers Street or the Embankment, a notice pointing to the "National Gas Exhibit" immediately meets the eye, and, altogether, this exhibition should be of considerable value to the Industry. Judging by the interest displayed in it by the public on the opening day, the efforts of harassed Underground Officials to control the crowds, and the lack of attention to duty of ticket inspectors in the vicinity, it should prove an undoubted success and will well repay a visit.

IN CONTINENTAL COUNTRIES - - -

Abstract Translations from the Technical Press of France and Germany.

BENZOLE RECOVERY.

O. Krebs in "Das Gas- und Wasserfach," 1931, 74, 1159-1165 (Dec. 12), gives working details of the performance of tower scrubbers in connection with benzole recovery.

The following details are given of the results achieved in three sets of scrubbers handling the gas produced in three batteries on one plant carbonizing blends of low-volatile and high-volatile coal. Each washer contained three towers packed with hurdles:

—	Plant 1.	Plant 2.	Plant 3.
Diameters of the towers, ft.	8·2, 8·2, 8·2	8·2, 8·2, 9·8	8·2, 8·2, 8·2
Height of the towers, ft.	65·6, 65·6, 65·6	82, 82, 82	65·6, 65·6, 65·6
Volume of the three towers, c.ft.	10,400	14,200	9,900
Tower volume per ton of dry coal carbonized per day, c.ft	30	22	26
Dry coal carbonized per 24 hours, tons	344	640	374
Hourly gas make, c.ft.	173,000	322,000	188,000
Benzole in crude gas, grammes per 100 c.ft.	80	92	92·5
Benzole in debenzolized gas, grammes per 100 c.ft.	7·0	18·4	19·7
Benzole scrubbed out, grammes per 100 c.ft.	73·0	73·6	72·8
Scrubbing efficiency, p.ct.	91	80	79
Gas velocity in the packed towers, ft. per sec.	1·83	3·38, 3·38, 2·36	1·99
Scrubbing period, minutes	1·80	1·38	1·57
Wash oil circulation, gallons per hour	2,220	3,080	2,640
Wash oil circulation, gallons per ton of dry coal	155	115	170
Water absorbed by oil, p.ct. on oil	0·26	0·30	0·24
Benzole absorbed by oil, p.ct. by volume	1·41	1·93	1·30
Benzole extracted per hour, gallons	31·5	59·2	34·2
Benzole left in the gas per hour, gallons	3·1	14·8	9·2
Further recoverable benzole per hour if residual benzole reduced to 5·7 grammes per 100 c.ft, gallons	0·6	10·2	6·6

The importance of using recovery plant of sufficient capacity is emphasized, and four towers of adequate height enable very efficient scrubbing to be realized. Higher concentrations in the benzolized oil can be realized by recirculating oil through some of the towers and only passing a portion of the oil in circulation from one tower to the next. The pumping costs are increased, but this is offset by the lower steam consumption required for debenzolizing.

The conventional arrangement of upward passage of gas through the towers was adopted in the plants for which details are given above, gas and oil being in countercurrent flow in the successive towers. The author, however, points out that equally good recovery would be realized if the gas were passed through the towers in a downward direction; and if this procedure were adopted, much less back pressure would be set up, and the cost of power supplied to the exhausters would then show a considerable annual reduction.

METHOD FOR MANUFACTURING DENSE PITCH COKE.

J. P. Koettnitz in "Brennstoff-Chemie," 1931, 12, 479-480 (Dec. 15), describes his experiences in the manufacture of pitch coke. In 1918 he found that, during the coking of pitch, those stills in which a blockage had occurred and had been removed gave a coke which was all the more dense and free from pores the longer the pressure had been present. Indeed, in some cases, the coke was almost like a fused mass and showed an extraordinary hardness—so much so that sharp-edged fragments would scratch glass.

The application of this discovery that the density of pitch coke is dependent on purely physical phenomena—pressure—was followed up since an appreciably denser pitch was required in the aluminium industry.

Owing to the danger of fracturing the retorts, it was not practicable artificially to create blockage in the still off-take pipes, thereby creating pressure. The following method was therefore adopted and proved successful. Distillation was interrupted when the thermometer in the vapour registered about 400° C., and the still was allowed to rest about two hours, during which period the temperature fell about 20° C. Intense firing was then commenced, and the still contents were strongly ignited. The process was carried out successfully on a large scale from 1919-1925 with an annual capacity of 32,000 tons for the production of dense, almost ash-free coke. The frothing-up of the pitch during distillation must be counteracted by allowing the fluid or pasty mass to subside after the elimination of the main fraction of the volatile constituents. Charges which are treated thus are described as settled or squatted. The correct stage for the interruption must be chosen. This depends on the nature of the pitch.

THE RESINIFICATION OF MOTOR BENZOLE.

H. A. J. Pieters and H. S. Visser in "Brennstoff-Chemie," 1931, 12, 470-472 (Dec. 15), describe experiments on the gumming propensity of the fore-runnings (66-85° C.), the middle fraction (85-116° C.), and the tails (above 116° C.) of crude benzole and show that the large middle fraction which amounts to about 65 p.ct. of the whole develops very much less gum in the accelerated gum test than do the other fractions. They therefore come to the conclusion that refining of this fraction is not only unnecessary but is undesirable, since by omitting the acid refining process the olefines are left in the benzole, and the quality of the motor fuel is thus improved. Rational refining procedure is thus to fractionate the crude benzole making cuts at the two temperatures which prove to be the most suitable and to refine only the fore-runnings and tails of the motor benzole fraction. The low gumming propensity of the middle fraction may be due to the presence of inhibitors of gum formation.

The acid wash test should not be employed for motor benzole made by the method described.

The Position of the Gas Off-Take Pipe in Carbonization

The general problem of the position of the gas off-take pipe in carbonization is of interest both in high and in low temperature carbonization, because by the position selected for the pipe, the heat treatment of the products of carbonization may be profoundly modified

By G. E. Foxwell, D.Sc., F.Inst.P., F.Inst.F.

This article, which has been prepared at the request of the Editor of the "Gas Journal" as a digest of the practical points from a scientific paper by the present author upon the same subject in "Fuel," January, 1932, deals essentially with the position of the gas offtake pipe in the bye-product coke oven. The normal ascension pipe may be placed either at the end or towards the centre of the oven roof. The exact position is immaterial so far as it affects the heat treatment of the products of distillation or the time which they spend in the coke oven. The particular problem to be discussed here is the withdrawal of the gases from the interior of the coal by embedding the gas offtake pipe in the coal charge itself. It is the purpose of this paper to describe briefly an investigation into the possibility of adopting a process of this nature and in the results to be expected.

Many attempts to do this have been made during the past fifty years. As long ago as the year 1889, Brunck took out German Patent No. 51,518 for a process in which the coal was to be compressed against the walls of the coke oven in order that the whole of the gas could take its path through the uncarbonized coal.

Peters ("Journal fur Gasbeleuchtung und Wasserversorgung," 1908) described experiments made upon coke ovens heated on one side only in which attempts were made to withdraw the gases through openings in the non-heated wall; these tests, however, failed to achieve their object, and the gas passed wholly upwards along the heated wall.

Salepa, Wittmann, and Ressel, of Witkowitz, in 1921, took out two German Patents, Nos. 368,085 and 368,281, in which the gases were to be extracted through vertical pipes or horizontal hollow spaces in the centre of the charge.

Finally, British Patent No. 351,872 has just been granted to Dr. Carl Still in which the gases are to be withdrawn from the chamber by tubes provided with slots which are sunk into the interior of the coal.

To discover what is likely to happen when the attempt is made to withdraw gases from the centre of the charge by pipes sunk into the coal, it is first necessary to consider the possible paths open to the gases and the resistances which the gases may encounter in traversing these paths. The progress of carbonization in a coking coal may be conveniently divided into three stages, the temperature limits of which will vary with the class of coal being carbonized. In the case of a typical South Yorkshire coal, for example, from atmospheric temperature up to 370°—400° C., the coal shows no visible signs of physical change, but there is evolution of gases largely consisting of carbon dioxide and water vapour accompanied by a little combustible gas. At this temperature the coal begins to swell and become plastic, the plastic stage lasting until about 470° C. At 470° C. the coal has been converted into coke and subsequent changes are mainly chemical.

The quantity of products evolved during each of these three stages is shown in Table 1 in the case of a South Yorkshire coal. From these figures, it will be seen that at temperatures below 400° C. considerable quantities of tar and other oils are obtained, which in any case could be expected to be withdrawn easily through the centre of the charge. These oils and tars, however, are of a primary nature and consist simply of low-temperature tar. On the other hand, the quantity of gas which is evolved below the plastic limits is small and nearly 90 p.ct. of the permanent gas is evolved above the plastic limits. Clearly the mental picture that we must have of the coke oven during the progress of carbonization is that against the wall is a layer of coke which merges gradually through semi-coke into the upper limit of the plastic zone. Throughout the plastic zone the coal is a semi-molten highly compressed mass, in passing through which the gas encounters a more or less high resistance according to the nature of the coal. Finally, the plastic zone gives way to uncarbonized coal which fills the centre of the oven and in which the offtake pipes are embedded if it is attempted to withdraw the gases through the centre of the charge. The greater portion of the gas is generated in the coke, and most of the gas has thus the choice of two paths by which to reach an embedded offtake pipe. Considering a particle of gas generated at E (fig. 1), the first of these paths is EC—through the semi-coke, through the plastic layer into the coal, and thence to the offtake pipe. The second of these paths is to proceed upwards through the coke, EBA, into the free space above the charge, to pass over the top of the plastic layer to D, and thence down into the centre of the coal. There is the further important point to be noticed that the radiation from the top of the oven, possibly assisted by hot gases endeavouring to take the path EBAD, gives rise to a top plastic layer lying above the coal.

Resistances to the Flow of Gas.

In order to decide which path the gases are likely to take, it is first necessary to measure the resistances to the flow of gas of coal or coke in various stages of carbonization, and of the vertical and top plastic layers. For most of the experimental methods used, readers are referred to "Fuel" (*loc. cit.*), and it will here be only necessary to give the experimental results except in the case of the method used for determining the resistance of the vertical plastic layer.

The following calculation leads to a deduction of the path taken by the gases in a normally operated coke oven. Following the author's earlier work upon the same subject ("Fuel," Vol. III.), the resistance to the flow of gases of the materials used are expressed by the factor m, where:

m = the pressure in mm. W.G. required to pass gas at the rate of 1 c.c. per minute measured at N.T.P. through 1 cm. cube of the material at a temperature of t° C.

In addition to the term m, just defined, it is also convenient to use an expression for the total resistance of the plastic layer, R, where:

R = the pressure in mm. W.G. required to pass 1 c.c. of gas per minute through the whole width of the plastic layer over a cross-sectional area of 1 sq. cm.

For the calculation, two cases may be taken, in one of which the plastic layer has a high total resistance, and in the other one it has a low resistance. The experimental figures determined for m and R are as follows:

Coal at 100° C.	m = 0·0134
Coke near plastic layer at 600° C.	m = 0·003
Coke near wall at 900° C.	m = 0·000085
Vertical plastic layer (*a*) Total resistance	R = 200
Vertical plastic layer (*b*) " "	R = 4
Top plastic layer (taken as)	0·2 R

For the purpose of calculating the resistance of the possible paths open to a particle of gas, it is assumed that the disturbances created by the presence of other particles of gas generated at all parts of the oven at the same instant are not taken into account. The full solution of this problem leads, indeed, to simultaneous differential equations which are not soluble by known mathematical methods. Consider 1 c.c. of gas generated per minute at E, and assume that no other gas is being produced in the charge. To give a preliminary numerical illustration, let E be situated 10 cm. from the heated wall, 5 cm. from the plastic layer, and 300 cm. below the top of the charge. The oven is operated in the normal manner without internal pipes inserted in the coal.

Case A. Coal Yielding a Plastic Layer of High Resistance.

This is the general case since it is that most commonly applicable to coking coals.

Resistance of path EBA = 10 × 0·000085 + 300 × 0·000085
= 0·0255 mm. W.G.

Resistance of path ECD = 5 × 0·003 + 200 + 300 × 0·0134 + 200 × 0·2
= 244·035 mm. W.G.

The path, ECD, through the plastic layer has thus a resistance nearly 10,000 times as high as the path EBA through the coke. The amount of gas generated on the hot side of the plastic layer is never more than twenty times that generated on the cool side, so that the vast discrepancy between the resistance of the two paths cannot be

compensated by the greater quantity of gas which has to take the path of lower resistance.

In most coking coals, which yield a plastic layer of high resistance, this plastic layer thus acts in normal coking practice as an impermeable barrier between the hot and cool zones of the oven and only volatile matter evolved below, say, 430° C.—midway through the plastic layer—can pass inwards through the coal. This volatile matter, however, contains a considerable quantity of primary tar and light oils, the lighter portions of which find their way into the tar and benzole, and, being paraffinoid in character, depreciate the value of both these products. These paraffinoids can best be transformed into benzenoid bodies by submitting them to a moderate degree of heat in the free space.

Case B. Coal Yielding a Plastic Layer of Low Resistance.

Resistance of path EBA = $10 \times 0{\cdot}000085 + 300 \times 0{\cdot}000085$
= 0·0255 mm. W.G.

Resistance of path ECD = $5 \times 0{\cdot}003 + 4 + 300 \times 0{\cdot}0134 + 4 \times 0{\cdot}2$
= 8·835 mm. W.G.

The path ECD has thus 350 times as high a resistance as the path EBA.

In this case, there is a possibility that some gases will pass inwards through the plastic layer, but it is clear that unless a considerable suction is applied to the coal from inside the charge, the bulk of the gases will still pass upwards through the hot coke against the oven wall.

The introduction of pipes and holes in the cold core of the charge causes in effect the removal of a portion of the path CD, so that the resistance encountered in case A by a particle at E in passing through the plastic layer to the vertical holes becomes $5 \times 0{\cdot}0003 + 200 + 15 \times 0{\cdot}0134$[1] = 200·17, the total resistance being thus a little less than 8000 times the resistance of the path EBA—*i.e.*, the effect of introducing the vertical pipes is inappreciable unless assisted by a high suction.

In the preceding calculation the resistance of the top plastic layer has been regarded as always equal to 0·2 R—*i.e.*, one-fifth of that of the vertical plastic layer. It is found experimentally, however, that the resistance of the top plastic layer depends upon whether the gas is being passed upwards or downwards. If cool gas from the centre of the oven is being passed upwards through the top plastic layer, this resistance is comparatively small, although it may temporarily attain quite a high value. For the most part, however, gases can pass upwards through the top plastic layer without requiring an excessive amount of pressure to enable them to do so, and the value 0·2 R is not greatly in error. When, however, the hot gases are passing downwards, the resistance of the plastic layer becomes far greater than this with most coking coals, and even when using suctions as high as 400 mm. mercury it generally proved impossible in the experiments made to withdraw gases through the top plastic layer. In this case, therefore, there can be no doubt that when withdrawing the gases from the centre of the charge they could not possibly take the path EBAD. With some coals and particularly with the poorer coking coals this very high resistance of the top plastic layer was not observed, and clearly both paths might be open to the gas. It is clear, therefore, that when withdrawing the gases from the centre of the charge, the only possible path is that from the coke through the plastic layer and into the coal—*i.e.*, the path EC (fig. 1); whereas when the gases are withdrawn from the oven in the normal way by an ascension pipe connected directly with the free space the only possible path for the gases generated in the coke is EBA.

Further calculations which need not here be given in detail enable the practical conclusion to be drawn that in coals giving a plastic layer of high resistance, the suction necessary to draw the gases through the plastic layer to the pipes or holes bored in the coal is between 1000 and 3000 mm. W.G., whereas quite a moderate suction will suffice for the purpose with a coal of low plastic resistance. With a coal of even moderate plastic resistance—*e.g.*, R = 50—the resistance to be overcome is over 300 mm. W.G.

It is important to ascertain the resistance of the vertical plastic layer at various times during the carbonization period, as this has an important bearing on the feasibility of a process of this nature. The experimental method is given in fig. 2. A well-insulated furnace was constructed to represent half the width of a coke oven. In this "oven chamber" were placed four silica tubes, each having a cross-sectional area of 32 sq. cm. and each containing a coal to be tested. It is thus possible to make four determinations at the same time. Each of these silica tubes was connected with a pressure gauge, a flow meter, and finally a suction pump. The space in the oven chamber around the silica tubes was filled with South Yorkshire coking coal. The coal was carbonized in a manner which will be clear from the figure; the rate of heating was so adjusted by preliminary trials that the temperature in the coal between 300° C. and 550° C.—*i.e.*, throughout the whole of the plastic stage—increased at the rate of 2° C. per minute, which is comparable with modern coking practice. The results of the determination of R upon five coals are as follows:

—	Silkstone.	Parkgate.	S. Yorkshire Coal "K."	Parkgate/ Semi-Coke Mixture.	Derbyshire Coal.
1st hour . .	16	15	2·5	4·9	56
2nd ,, . .	99	232	22·4	10·8	128
3rd ,, . .	547	162	16·6	10·6	96
4th ,, . .	214	305	6·2	9·2	143
5th ,, . .	910	760	4·1	10·4	119
6th ,, . .	..	408	2·8	9·0	283
7th ,, . .	365	166	1·1	5·8	119

It is important to notice that the resistance of the vertical plastic layer may be very high indeed with strongly coking coals, although comparatively moderate with poor coking coals, but perhaps the most important observation is that the resistance of the plastic layer is not constant,

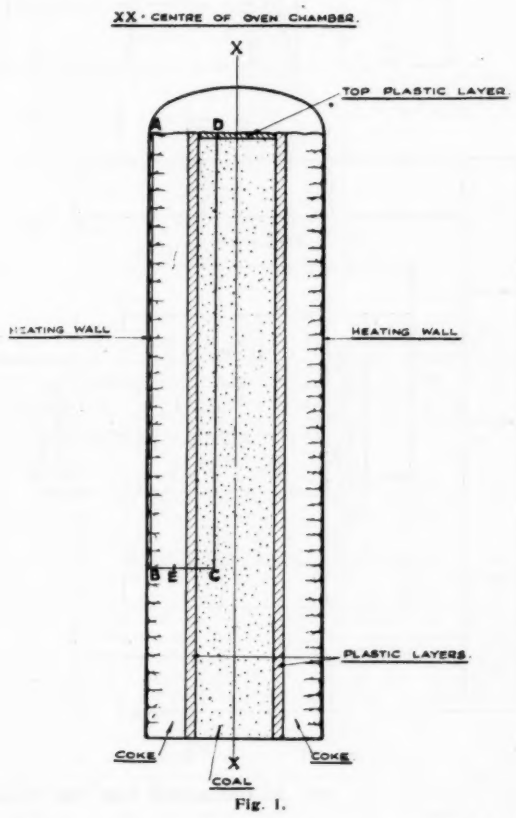

Fig. 1.

but varies as the carbonization proceeds. Clearly the practical significance of this variation is to render any process for withdrawing the whole of the gases from the centre of the oven impossible. It does not seem feasible to devise any method which will enable the suction applied to the centre of the charge to be varied with the resistance of the plastic layer. When carbonizing a good coking coal, the suction required must evidently be between 1000 and 3000 mm. W.G., and at times this suction will be so much too great that volumes of furnace gases will be drawn in from the flues, whereas at other times it will not be sufficiently great to prevent loss of distillation gases to the flues.

The general conclusion from these theoretical discussions is that any process for withdrawing the gases in the coke oven from the centre of the charge, although subject to difficulties, may be effective with coals having a low plastic resistance, but cannot be practicable, even though possible under laboratory conditions, with coals having a high plastic resistance.

Clearly it is important to test the validity of these conclusions by a direct method. The direct method consists in carbonizing known coals in a rectangular retort and in endeavouring to withdraw the gases from the centre of the coal by means of vertical pipes in the charge. The apparatus used for the purpose is shown in fig. 3, and

[1] 15 × 0·0134 is an approximate measure of the resistance of the coal between the plastic layer and the vertical holes.

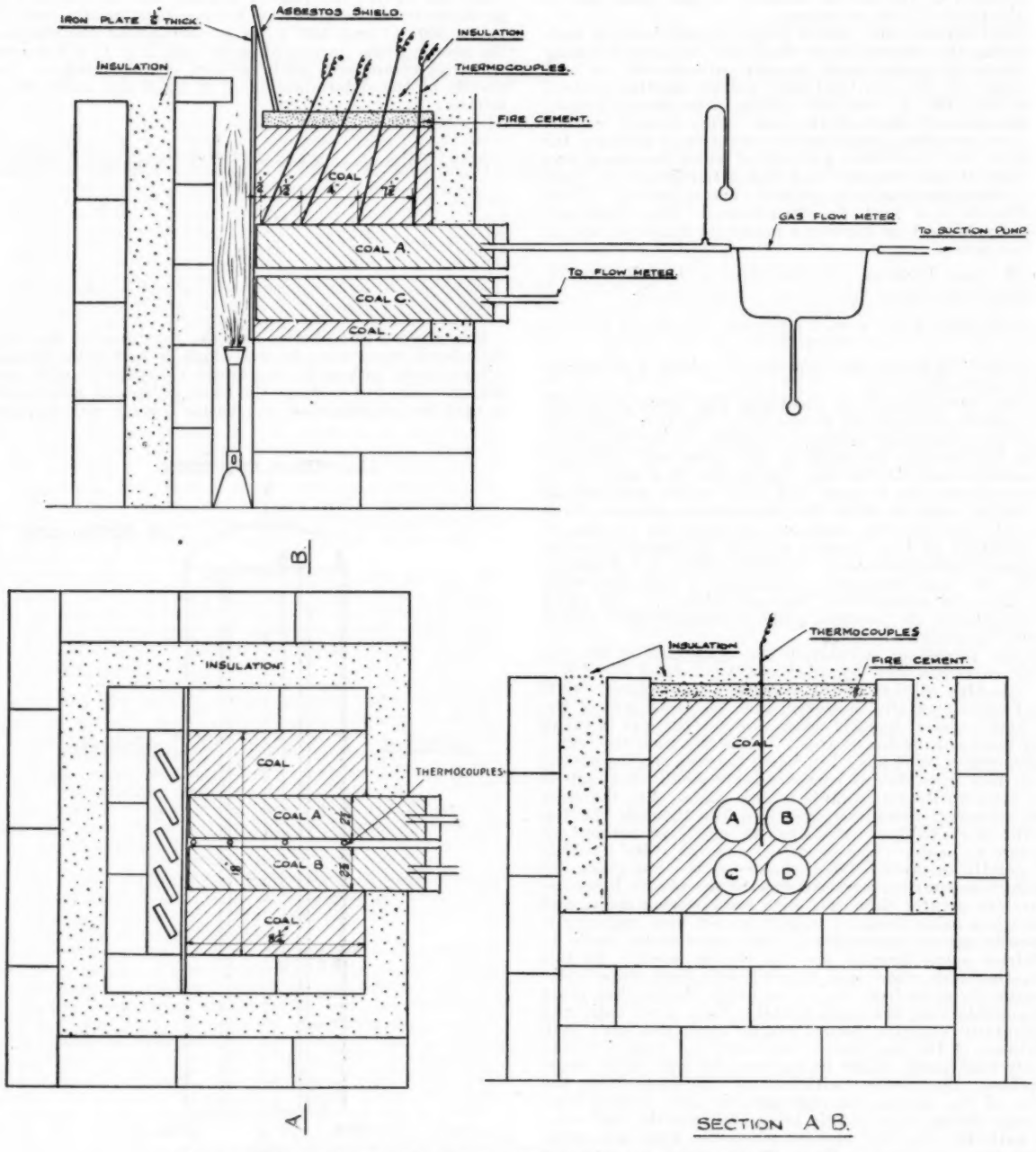

FIG. 2.—APPARATUS FOR THE TOTAL RESISTANCE (R) OF THE PLASTIC LAYER.

consists of a rectangular iron retort 50 mm. in width, placed in a suitable furnace. The coal in this retort was carbonized in 3 hours—that is to say, the rate of heat flow from either side was about 8 mm. per hour. No unduly high plastic resistance should, therefore, result from too rapid heating. On account of the low coking velocity, particularly favourable conditions were created for the passage of the gas through the plastic layer. The offtake pipe was connected to a condenser, tar and liquor receiver, cotton-wool extractor for tar fog, a differential flow meter, and finally to a suction pump and sampler.

Several modifications of the method of charging the retort could be adopted. The coal could be charged normally, and both pipes inserted in vertical holes in the interior of the charge; the coal could be charged normally, and one pipe put into the interior of the charge and one used to represent an ordinary ascension pipe; and, finally, the arrangement shown in fig. 3 could be adopted in which the coal was securely covered with a layer of gas-tight firecement (consisting of a mixture of special "Sairset" cement with sodium silicate), care being taken to leave a space against the walls of the retort through which the gas could flow.

In the first series of experiments a good coking coal of high plastic resistance was used. The retort was charged with a South Yorkshire coking coal, consisting principally of a mixture of the Parkgate and Silkstone seams, weighing 2000 grammes and containing 12 p.ct. of water. The retort was heated from the cold after the charge was put in. Almost immediately after the commencement of heating, large volumes of water distilled over through both outlet pipes. A separate train of apparatus was, of course, connected to each outlet pipe. During the heating-up period, the gauge attached to the two offtake pipes registered similar readings, and any alterations made to the one affected the other. After a time, with the maintenance of a level gauge in the free space, the gauge in the internal pipe (B) showed a suction, and it soon became possible to keep level gauge in the free space while maintaining a suction of several inches W.G. in the internal pipes. From time to time, a rod was passed down both pipes to ensure that they were clear.

During the course of the experiment, the rate of gas evolution through the free space pipe (A) increased considerably, and reached a high value, whereas the evolution of the gas through the internal pipe steadily decreased, and finally ceased altogether. Local outbursts of gas, accompanied by light tar vapours, were to be seen issuing from the internal pipe. These were presumably due to local breaks in the plastic layer. For the same reason, light tar distilled at intervals through the internal pipe accompanied by small quantities of gas.

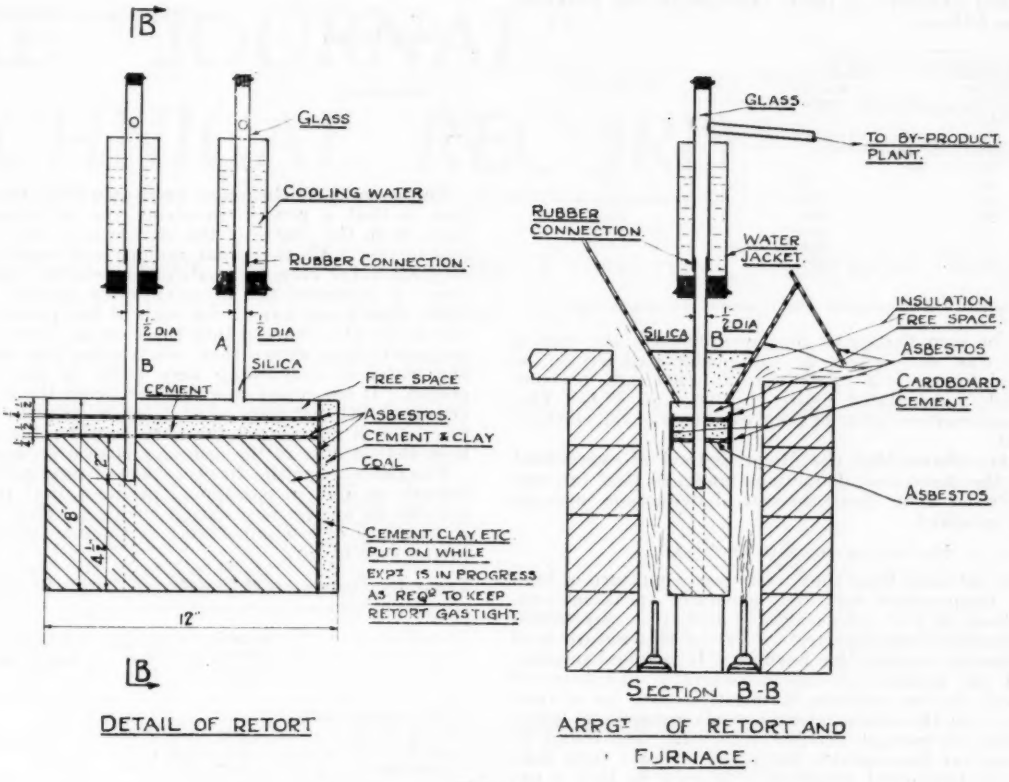

FIG. 3.

This experiment was repeated with precisely similar results. The total quantity of gas evolved throughout the experiments was as follows:

Experiment 1*a* . . . . . 1·75 kgs. coal used
" 1*b* . . . . . 1·85 " "

Experiment No.	Free Space Pipe (A).			Internal Pipe (B).		
	Litres.	P.Ct. of Total Gas Measured.	Cub.m. per Ton Coal.	Litres.	P.Ct. of Total Gas Measured.	Cub.m. per Ton Coal.
1*a* . . .	400	87·8	228	56	12·2	31
1*b* . . .	380	84·3	205	71	15·7	40

The analysis of the gases (not corrected for extraneous air) obtained during these tests was as follows:

—	Experiment 1*a*.		Experiment 1*b*.	
	Free Space Pipe (A.)	Internal Pipe (B).	Free Space Pipe (A).	Internal Pipe (B).
CO_2	1·8	3·7	2·3	3·8
O_2	0·0	0·9	0·6	1·0
C_mH_n	1·1	4·6	2·1	2·2
CO	3·8	1·8	3·6	1·6
H_2	55·1	8·8	50·0	24·2
CH_4	36·2	74·6	37·0	61·2
N_2	2·0	5·6	4·4	6·0

This series of experiments clearly shows that the gases from the internal pipe are true low-temperature products, and only the gases generated on the inside of the plastic layer can be drawn inwards with a suction of 5 in. W.G. This result is in accordance with the theoretical deductions. It remained, therefore, to determine whether the calculated degree of suction was actually required to be applied to the centre of the charge in order to withdraw the whole of the gases inwards with a coal of low plastic resistance and with a coal of high plastic resistance.

For a coal of low plastic resistance a South Yorkshire coal "K" was used. In performing this experiment, it was intended not to use the offtake pipe, A, situated in the free space above the charge unless it proved impossible to withdraw the products through the internal pipe, B.

Calculations which space does not permit to be given in detail here, but for which the reader is referred to "Fuel" (*loc. cit.*), show that with this coal it should be possible to withdraw all the gases through the centre of the charge with a suction of 84 mm. W.G. The experimental results show that the resistance of the plastic layer varied in exactly the same manner as that deduced from the experiments conducted in the apparatus given in fig. 2. At first the resistance was small; then it increased; finally it rose to a peak value, which, however, was only maintained for a few minutes, after which it again fell to its normal value.

It is significant that the order of magnitude of the suction required to draw the whole of the gases through the internal pipe as determined in this experiment is remarkably similar to the calculated suction.

In conducting the experiment, a tube was left in the top of the retort connecting the free space to the atmosphere, similar to the well-known flare pipes which are sometimes used even to-day on the older coke oven plants as a guide to the exhauster men. The suction throughout the experiment was so regulated that only occasional puffs of gas escaped through this pipe. It will be of interest to give the figures for this experiment in detail and these are contained in Table II.

It yet remained to determine whether the calculated suction was necessary and equally effective in the case of a coal of high resistance. In this experiment, which was conducted upon Parkgate coal, only the internal pipe B embedded in the coal was used, and the retort was filled right to its roof with coal. Any gases which could not be withdrawn from the centre of the charge would thus burst through the clay luting of the door and escape into the atmosphere. As before, a flare pipe was used to determine when the suction required was sufficient. Calculation showed that in this case the suction theoretically required should be 2400 mm. W.G.

Very considerable difficulty was found in completing an experiment, and, indeed, it proved impossible to do so except by heating with a lower flue temperature to reduce the plasticity of the coal. The reason for this was that with normal heating the coal became so plastic that the pressure set up in the plastic layer caused it to flow into the vertical pipes and to block them completely. Not even by very frequent poking with a rod was it possible to keep these pipes free. A variety of devices was tried to overcome this difficulty, but all were unsuccessful, although some of them enabled the carbonization to be continued for a sufficiently long period of time to enable a reliable measurement to be made of the suction required. It is evident that in practice there will be considerable difficulty in keeping the pipes free; and indeed it will evidently be necessary to revert to the normal ascension pipes when carbonizing a coal of moderately high plastic resistance as soon as the plastic layer approaches to within 2 or 3 cm. of the centre of the charge.

A typical example of these experiments on Parkgate coal is as follows:

Time After Start of Heating.	Suction Required. Mm. W.G.	Total Gas Passing. C.c. per Min.
Hrs. Mins.		
0 15	2	320
0 25	2	740
0 30	1	740
0 40	53	1700
0 45	2360	2500
0 50	2420	3000
1 0	2400	3100
1 5	7500*	800*
1 10	8000*	250*

* Off-take pipe becoming blocked; after 75 minutes blocked completely.

It will be seen that until the pipes blocked, the suction required was very close to that calculated from the theoretical figures—viz., 2360 mm. to 2400 mm. as compared with a calculated figure of 2400 mm. W.G. This affords confirmatory proof of the correctness of the methods here used.

It is thus shown that the direct method of experiment confirms the theoretical deductions made, so that the conclusions based upon these theoretical deductions may be regarded as sound.

Nature of the Tar Obtained.

The tar obtained from these tests was a mixture of high and low temperature tar, and, generally speaking, contained about 30 p.ct. of paraffinoid bodies as ascertained by the di-methyl-sulphate tests. Tar of this nature is of little value except, say, for burning. It is found in practice that the presence of any considerable quantities of paraffinoids in tar renders it unsatisfactory as a road material; even the comparatively small proportions which are present in normal vertical retort tar are found to render this tar less suitable for road purposes than coke oven tar or horizontal retort tar. It may be that a use will be found in the future for low-temperature tar, but, if so, it will be just as great an objection for it to be mixed with high-temperature tar as it is now for high-temperature tar to contain any low-temperature product. The quality of the tar, therefore, seems to be a definite handicap to any process involving the withdrawal of the gases through the centre of the charge. Similarly, the benzole obtained is greatly contaminated with paraffinoid bodies, and while quite suitable for motor fuel, would be unsuitable for the dye industries.

Quality of the Gas.

The less decomposition of the tar reduces the gas yield very considerably. The gas, as would be expected, is of a high calorific value, rich in methane and low in hydrogen. The calorific value of the gases as obtained in the experiment on South Yorkshire coal "K" was 660 B.Th.U. per c.ft. gross, while the yield was only 9200 c.ft. per ton. The absence of opportunity for decomposition of tar and water thus reduces the gaseous therm yield from about 70 therms per ton, which would be expected, to 61 therms per ton.

Effect of Flue Temperature.

Any process for withdrawing the gases from the centre of the oven will depend primarily for its success upon the resistance of the vertical plastic layer. It is important to notice that the resistance of the vertical plastic layer depends greatly upon the rate at which the coal is raised in temperature. The relative resistance of the plastic layer may be deduced from the area of the plastic curve as determined in the standard plastic curve apparatus. The following are the relative increases in plastic resistance from two coals:

It is clear that the slower the rate of heating—that is to say, the lower the flue temperature of an oven—the lower is the suction necessary to withdraw the gases from the centre of the charge.

Rate of Heating.	Relative Resistance of the Plastic Layer.	
	Coal No. 1.	Coal No. 2.
1° C. per minute . .	1	1
2° C. ,, ,, . .	4	7
3° C. ,, ,, . .	8	8
4° C. ,, ,, . .	12	36

The general conclusion to be drawn from this investigation is that a process involving the withdrawal of the gases from the centre of the charge in a coke oven is impracticable with the great majority of coals and is not of great value even for coals of low plastic resistance, because it produces tar of an inferior quality. The only value that it can have is for coals of low plastic resistance, which are also charged into the oven in a wet state. Experiments have shown that, when using the internal pipe, the water is evaporated very early in the carbonizing period. If the water is withdrawn from the centre of the charge it will not pass against the oven wall, and, therefore, it will not absorb the very considerable amounts of heat that it does in the ordinary coke oven process.

The process has the disadvantage of producing a tar and benzole so high in paraffinoid products that they are unsuitable for any purpose except burning. This is, of course, a drawback of less importance in the case of benzole than in the case of tar.

Table I.—*Temperature of Evolution of Volatile Products from Coal.*

—	Volatile Matter Evolved. P.Ct.	Primary Tar. P.Ct.	Water of Distillation. P.Ct.	Gas. Litres per 100 Grams. of Coal at 15° C. and 760 Mms.
South Yorkshire coal—				
Below 400° C. . .	9·22	3·72	3·89	1·55
400° C.–470° C. . .	4·5	0·7	2·0	2·0
Above 470° C. . .	20·12	3·28	4·65	22·45
Total . . .	33·84	7·7	10·54	26·0
Works results . .	31·4	5·0	6·4	31·8

Table II.—*Carbonizing Results on South Yorkshire Coal "K" of Low Plastic Resistance.*

Coal used: 1400 grams dry.
1650 grams wet.

Time.	Suction.	Rate of Gas Evolution.
Hrs. Mins.	mms. W.G.	C.cs. per Minute.
0 0	0	..
0 10	1	180
0 25	1	230
0 40	1	570
0 45	3	1410
0 50	3	1640
0 55	2	1870
1 0	2	1870
1 5	4	1930
1 10	5	1990
1 15	50	1990
1 20	90	2490
1 25	390	3870
1 30	163	2960
1 35	57	2870
1 40	68	2990
1 45	62	3300
1 50	78	2970
1 55	55	2860
2 0	41	2750
2 5	38	2860
2 10	22	2640
2 15	25	3190
2 20	15	3080
2 35	15	2860
2 40	9	2200
2 45	8	1980
2 50	6	1320
3 0	3	660
3 15	3	90

All gases withdrawn through central pipe.

THE "JOURNAL" TECHNICAL RECORD

Which contains Reports of Meetings of Gas and Allied Associations

An Experiment in Controlling Pressure Conditions Within Coal Gas Retorts

By R. N. Webb. Leeds Corporation Gas Department

Supplement to the Author's Paper before the Institution of Gas Engineers, June, 1931

In my paper, "An Experiment in Controlling Pressure Conditions within Coal Gas Retorts," which was presented at the 68th Annual General Meeting of the Institution and which is published as Communication No. 32, the charts illustrated in Fig. 7 indicate pressure at the foul main, and it may be thought that they do not necessarily represent the conditions prevailing within the retorts. Fig. 8 shows two charts, one being the usual daily chart from the foul main and the other a 24 hours' record taken from a mouthpiece lid on an "Arkon" recorder with a magnified scale of 10 to 1. The retort that this is taken from is at the opposite end of a bench of 14 beds of retorts to that of the daily chart.

I wish to draw attention to the similarity in pressure of the two charts and also to the fact that after the retort has been charged, &c., and the dip-pipes lifted, the pressure quickly assumes that of the rest of the system and is maintained at that throughout the carbonizing period. This record corroborates previous individual comparisons made between the recorder and xylol slope gauges. These conditions are probably due to the areas of the ascension pipes, hydraulic mains, foul mains, &c., being sufficient—a very desirable feature.

A survey of the pressures in the setting, on the outside of the retorts, has influenced us in adopting the 1/20-in. W.G. pressure within the retorts.

Low Nitrogen Content in Crude Gas.

A low nitrogen content in the crude gas is, I think, generally regarded as a good indicator of satisfactory working conditions. Numerous tests taken from the foul main show that it varies approximately from 2 per cent. to 4·5 per cent., and in Fig. 9 a few typical results recently obtained are recorded.

—	May 14.	May 15.	May 20.	May 21.	May 22.	May 23.	May 28.
Per Cent. nitrogen	4·2	2·0	2·3	3·5	2·3	3·0	4·8

Fig. 9.—*Nitrogen Content of Period Gas Samples taken from the "Foul Main." Results given "Air Free."*

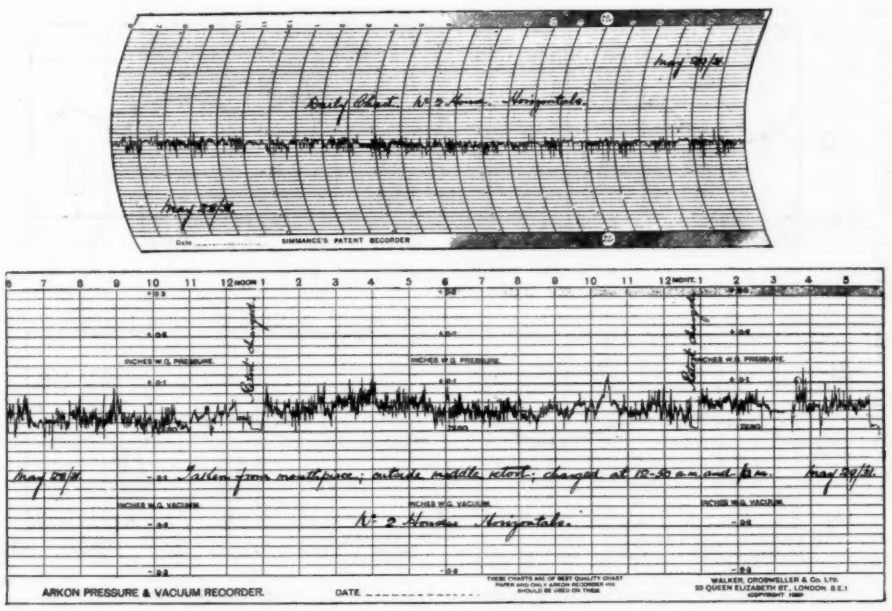

Fig. 8.—*Similarity of the Pressure at Foul Main to that at Mouthpiece.*

It should be noted that the above tests and those given in Fig. 10 were taken from retorts that had been working over 2500 days prior to the test being made.

Following the satisfactory tests for nitrogen, hourly samples of gas were taken from an outside top retort during the whole 12-hour carbonizing period of a 13 cwt. charge of coal. Analyses of these are shown later, Fig. 10.

I submit that these analyses indicate a very good quality gas; the sulphuretted hydrogen, heavy hydrocarbons, and methane are at a maximum during the early stages and fall away as carbonization proceeds, but the methane does not fall so low as usual during the later stages. The hydrogen shows the customary increase. The point I wish to emphasize, however, is that the nitrogen content throughout the period is low.

We have no facilities for measuring the rate of gas production from a single retort, and therefore it is not possible to give a true average composition of the total gas made. The analyses indicate, however, that the

Hours	1	2	3	4	5	6	7	8	9	10	11	12
H_2S	2·8	3·1	2·4	1·7	1·3	1·2	1·2	1·1	0·8	0·9	0·8	0·5
CO_2	3·5	3·2	2·6	2·7	2·3	2·2	2·5	2·3	2·3	1·7	1·3	1·5
C_nH_m	6·3	6·2	5·3	4·9	4·3	3·4	3·4	3·3	2·8	2·5	1·4	1·0
CO	7·2	7·0	6·8	6·6	6·5	7·0	7·1	5·5	7·8	6·7	6·8	5·9
H_2	18·6	22·8	31·5	42·4	46·2	48·9	48·8	55·2	56·1	57·2	61·9	64·8
CH_4	59·2	55·4	49·7	39·8	36·2	36·3	35·7	30·3	27·9	28·9	26·7	24·6
N_2	2·4	2·3	1·7	1·9	3·2	1·0	1·3	2·3	2·3	2·1	1·1	1·7
	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

FIG. 10.—*Typical Analyses (Air-Free) of Hourly Samples of Coal Gas taken from One Retort during a Twelve-Hour Carbonizing Period.*

calorific value is approximately 650 B.Th.U. gross and the nitrogen approximately 2 per cent.

LEAKAGE.

If the pressure conditions within the retorts are controlled so as to prevent the in-drawing of furnace gases, &c., it is very important that this is not done to such an extent that coal gas leaks from the retorts into the setting. All gas engineers no doubt have been conscious of this possibility for many years, in fact loss of gas due to porosity of retorts was one of the objections to those made of fireclay a century ago.

The prevention of this leakage, the proper balance of pressure on the inside and outside of the retorts, and allied problems have been frequently discussed during recent years by different authors in contributions to the various Gas Associations.

Mr. Rhead, in a paper given before the Institution of Gas Engineers in 1926, emphasized the importance of pressure control in vertical retorts and the possibilities of serious loss by leakage. I have, however, no knowledge of anything quantitative on leakage being published prior to the 12th Report of the Gas Investigation Committee of the Institution, presented in 1924. Here Dr. Parker obtained experimental data which enabled him to calculate the actual amount of leakage taking place.

Mr. Hollings, in a paper read at the 65th Annual General Meeting of the Institution in 1928, also referred to the leakage problem, and showed that under certain pressure conditions, particularly during the early stages of a carbonizing period, the leakage can become serious.

We have carried out some preliminary tests based on a comparison of the carbon dioxide in the theoretical products of combustion with the carbon dioxide actually present in the air-free waste gases, this being the method described by Dr. Parker and Mr. Hollings in their respective contributions.

While it is appreciated that this work demands great care and the use of precise methods of gas sampling and analysis, up to the present no results have been obtained which would lead us to believe that any appreciable leakage is taking place.

Fig. 11 shows two typical tests carried out on a setting that had worked about 2400 days prior to testing. The pressures in the retorts during these tests average 1/20 in. W.G., and the average carbon dioxide of the theoretical products from the producer gas was 20·5 per cent. It will be noted that the carbon dioxide content of the air-free waste gases varies only slightly except after clinkering, when a definite drop is noted. There is no indication of any systematic drop shortly after any retort is charged.

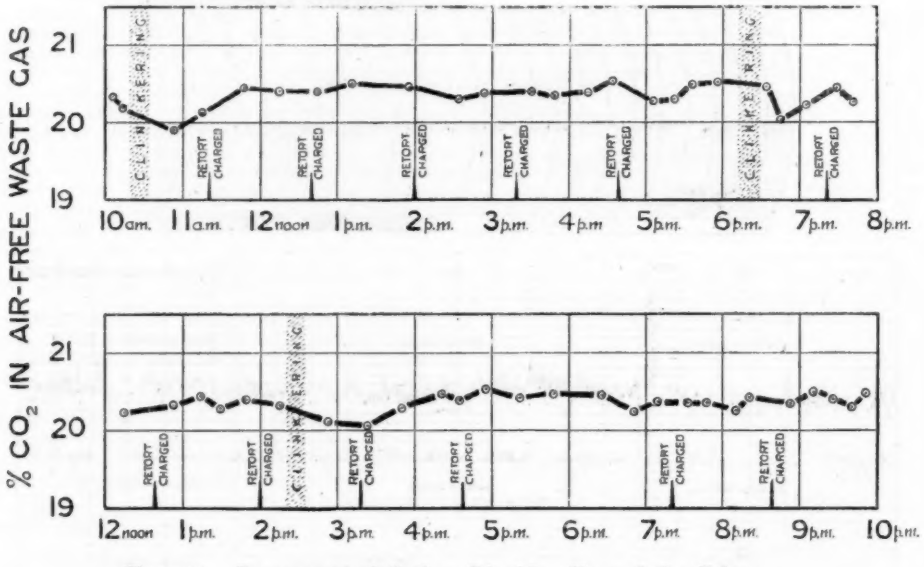

FIG. 11.—*Percentage of Carbon Dioxide—Normal Conditions.*

EFFECT OF EXCESSIVE PRESSURE WITHIN THE RETORT.

In view of these apparently very satisfactory results, a test was carried out on the same setting to try to detect leakage when excessive pressure was exerted within the retorts. The results are shown in Fig. 12.

The average carbon dioxide of the theoretical products from the producer gas was 20·35 per cent. It will be seen that under normal working conditions, with a pressure of 1/20 in. W.G. within the retorts, the results are similar to those shown in Fig. 11.

Sealing the anti-dips of each retort on one side only gave results which indicate a definite leakage. This was thought to be due to one or more of the retorts in the bed being packed with coal in the middle of its length, thus offering a resistance to the passage of the gas to the open ascension pipe at the other end and creating excessive pressure. There were no facilities at the time for

measuring the pressure simultaneously at each mouthpiece, but measurements taken at a later date show that such is the case, no increase in pressure being noted when there is a sufficient clearance over the coal charge throughout the retort.

As previously stated, these experiments are of a preliminary nature, and for that reason no attempt has been made at this stage to interpret them quantitatively. We consider the work very important, however, and it is being continued. From what has already been done,

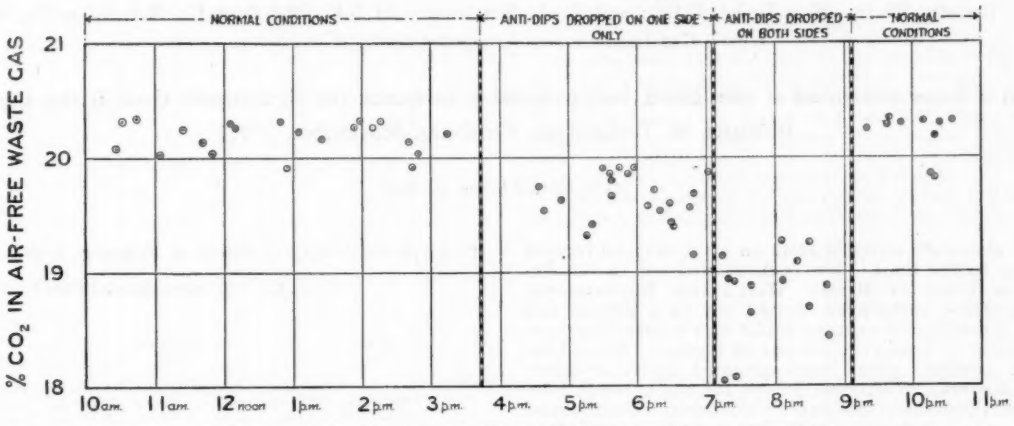

FIG. 12.—*Percentage of Carbon Dioxide in Air-Free Waste Gas—Normal Conditions and Excessive Pressures; the latter obtained by sealing anti-dips.*

Sealing the dips at both sides put on a pressure of approximately 1 in. W.G., and the results indicate very serious leakage. It is interesting to note how the conditions return to normal when the dips are again lifted.

there can be deduced the fact that fireclay and silica retorts are more or less porous, and a serious leakage, either outward or inward, can only be prevented by maintaining correct pressure conditions.

London and Southern District Junior Gas Association

Visit to Home Office Museum

A party of the London and Southern District Junior Gas Association, under the Presidency of Mr. J. H. Goldsmith, paid a visit to the Home Office Industrial Museum, Horseferry Road, S.W., on Saturday, Jan. 9.

The museum is intended to be a permanent exhibition of the best methods, arrangements, and appliances for ensuring the safety, health, and welfare of the human element in industry. Its establishment was decided upon before the war; but the building, though erected then, has only been equipped during the past four years or so. The museum, which is the only one of its kind in the country, is open to the general public in the mornings, and is available in the afternoon for visits by those who are concerned by the problems of safety, health, and welfare in industry. The exhibition space is on the ground floor and on the gallery, while in the basement is a lecture hall, together with rooms devoted to ventilation and lighting.

Industrial Safeguards.

The exhibits on the ground floor are devoted to safety means for industrial machines, such as wire guards for beltings, covers for shaftings, and devices for pushing the operators' hands clear of the mechanism of stamping, sawing, &c., machines, and interlocking devices for large laundry machines.

The gallery is devoted mainly to the welfare and medical sides. A number of cases containing plaster casts of limbs show various conditions and stages of industrial diseases, such as silicosis, metallic poisonings, anthrax, &c., together with explanations of their symptoms and treatment. Designs of gas masks, aprons, rubber gloves, &c., are exhibited, while a model works first-aid room and canteen are of interest. A further section is devoted to methods of electrical wiring, one exhibition case containing electrical fittings, all of which have been the cause of a fatal accident. An interesting demonstration shows the right and the wrong way of wiring up electric lighting fittings with switches, whereby in the one case all is properly insulated, and in another various metallic parts of the fittings become "live" at one or both positions of the switch.

An interesting exhibit is a new type of crane which may shortly be enforced for all public building work. This crane is set for a certain load, and if any attempt is made to lift a weight over and above this an automatic buzzer comes into operation.

Lighting Exhibits.

The lighting room is provided with a number of cabinets containing exhibits which are self-explanatory. The main objects of the exhibition are to illustrate the first principles of lighting, to show the relation between the nature of the work and the amount and kind of illumination required, and to draw attention to certain conditions found in factories which affect the efficiency of the lighting installation. The law of reflection of light, and its importance in connection with the position of light sources with respect to the work, are demonstrated by another exhibit; while the effect of the reflection factor of the work on the amount of illumination required is also shown. Other exhibits show the value of shadow as an aid to the discrimination of detail, and the disadvantage of shadows produced by unsuitable arrangements of light sources. Important exhibits are those which demonstrate the effect of illumination on the rate of perception, and the effect of direct glare from bright unscreened light sources near the line of vision. Not only are accidents caused by failure to provide sufficient illumination to permit the quick perception of obstacles or moving parts of machinery, and by the temporary impairment of vision brought about by glare, but serious loss of output also results from these conditions.

Two exhibits illustrate the importance of keeping lamps and fittings clean if loss of efficiency is to be avoided; and the effect of the colour of the walls of a room upon the illumination secured from a given installation is shown in another exhibit.

In the laundry section, a gas iron is on view as indicating what care has been exercised in its design to render it absolutely safe to use. Descriptive cards explain the safety devices on all the exhibits.

In addition to the exhibits contained in the room devoted to the demonstration of the principles and methods of illumination, the lighting installation throughout the whole museum is itself an interesting exhibit, a number of high-power gas lamps being included.

Steaming in Continuous Vertical Retorts

By M. Barash, Ph.D., M.Sc.Tech., F.I.C., and T. A. Tomlinson, M.B.E., M.I.Mech.E., M.Inst.Gas E., both of West's Gas Improvement Company, Ltd., Manchester.

[From a Paper presented at the Third International Conference on Bituminous Coal at the Carnegie Institute of Technology, Pittsburg, November, 1931]

(*Concluded from p. 36.*)

A more elaborate series of tests on what may be termed "steaming to the limit" has been carried out in the Research Gas Plant of Messrs. West's Gas Improvement Co., Ltd. These tests were carried out in a normal full size unit, a continuous vertical retort of a nominal carbonizing capacity of 5 tons of coal per 24 hours. The carbonizing and ancillary plant were operated under ordinary modern gas-works conditions, except for the extra regulation of coal throughput and rate of steaming. Each test of the series was run continuously for at least several days with a preliminary period for adjusting conditions. The heating of the retort was effected by means of producer gas from a standard, built-in, step-grate producer, fed with a portion of the coke from the retort.

The coal used in these tests was Wigan Arley Yard Nuts, a washed Lancashire coal, of medium coking and gas-making properties, of a standard quality and accepted as a more or less standard product because of the uniformity of deliveries and the large number of investigations which have already been carried out on it by this Research Department, the Fuel Research Board, and several other investigators. About 150 tons were used in this series of tests. The coal throughput in each test was regulated to give the maximum thermal output per ton at a predetermined calorific value, keeping the combustion chambers as near as possible to an average of 1300° C. At each setting of the extractor drive (regulating the throughput) the amount of steam was also regulated for optimum conditions, samples of gas being continuously withdrawn for analysis and control.

The whole of the steam required for this purpose and for the ancillary plant (exhauster, pumps, &c.) was produced in a waste-heat boiler attached to the setting.

As a preliminary to the results obtained, the following figures may be considered as generalizations, based mainly on actual analytical data combined with theoretical assumptions for which there is considerable and sufficient evidence.

Coal used: Arley washed nuts of composition—

Moisture	2 p.ct.
Ash	6 ,,
Volatile organic matter	32 ,,
Fixed carbon	60 ,,

Yield of straight gas without steaming—13,000 c.ft. at 550 B.Th.U. per c.ft.

Coke produced: 13·5 cwt. per ton of coal = 67·5 p.ct. of coal, containing—

Moisture	0·5 p.ct.	=	0·3 p.ct. on coal
Ash	8·9 ,,	=	6·0 ,, ,,
Volatile organic matter	1·0 ,,	=	0·7 ,, ,,
N + S + H	3·0 ,,	=	2·0 ,, ,,
Pure carbon	86·6 ,,	=	58·5 ,, ,,
	100·0		67·5

That is, one ton of coal on distillation leaves 58·5 per cent. (= 11·7 cwt.) of its weight as carbon in its coke. Assume the whole of this carbon converted to water-gas, *i.e.*, at 15·6 lb. carbon per 1,000 cubic feet, it would produce 84,000 cubic feet of water gas.

Complete gasification of *1 ton of coal* by distillation and steaming only would, therefore, give:

84,000 c.ft. of gas at 300* B.Th.U.		=	252 therms
+ 13,000 ,, ,,	550 ,,	=	71·5 ,,
= 97,000 c.ft. of gas at 334 B.Th.U. per c.ft.		=	323·5 therms

* Note.—The figure 300 B.Th.U. per c.ft. is used for the C.V. of water gas, as it is found that under the most ideal conditions, a water gas is never produced containing less than 5 or 6 p.ct. of inert gases (CO_2, &c.). It would, therefore, be incorrect to use the higher figure corresponding to pure CO or H_2.

Table E.—*Summary of Results of Steaming Tests—Arley Coal.*

[W.G.I. Co., Ltd.—Research Gas Plant.]

Test.	Coal.	Gas.					Steam.
	Per Retort per 24 Hours.	Per Ton of Coal.	C.V. per C.Ft.	Per Ton of Coal.	Per Retort per 24 Hours.	Per Retort per 24 Hours.	To Retort (Total).
	Tons.	C.Ft.	B.Th.U.	Therms.	C.Ft.	Therms.	P.Ct. of Coal.
A	5·70	16,970	503	85·3	96,730	486	6
B	5·05	19,120	472	90·2	96,650	455	8
C	4·71	22,600	445	100·6	106,475	474	14
D	3·90	27,380	423	115·8	106,800	451	24
E	3·35	30,350	401	121·7	101,660	408	31
F	2·30	43,370	373	161·8	99,750	372	52
G	1·85	53,180	360	191·4	98,380	354	66
H	1·33	70,000	350	245·0	93,300	326	95

This yield of 97,000 cubic feet or 323·5 therms of gas per ton of coal may appear to be a rather fantastic figure, but how nearly it has been approached and the possibility of its attainment is indicated in the following figures obtained in the tests referred to above. Actually, in these tests

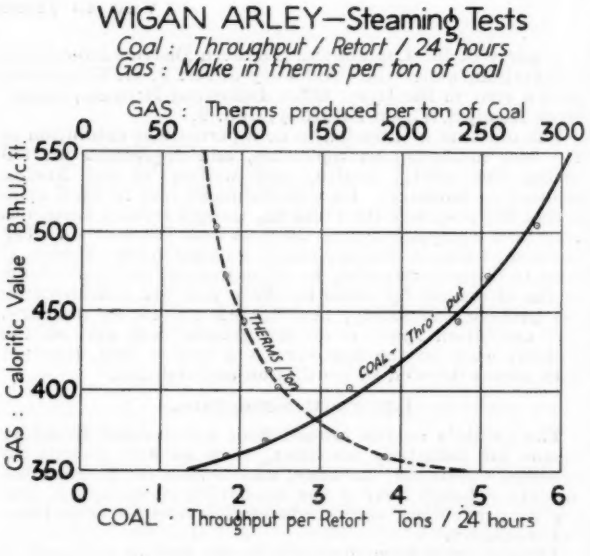

FIG. 3.

complete gasification was reached (and even surpassed), the last test (H) having to be discontinued owing to the fact that insufficient coke was being produced in the retort for the producer, the fuel requirements of this one retort setting (with a comparatively very large radiating surface for one retort) being excessive.

It is unfortunate that a straight-gas test could not be run on this series, as the plant was designed for steaming, and a sufficiently long run without any steam would have caused serious overheating of the bottom casting and extractor worm.

Figs. 3 and 4 represent graphically the chief items in Table C plotted against the varying calorific value of the gas.

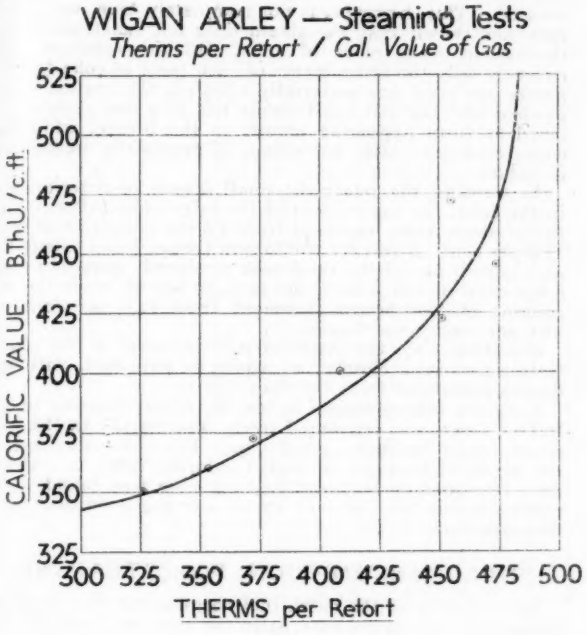

FIG. 4.

From the generalizations referred to previously it is a simple matter to calculate the yield of gas which should be obtained theoretically at any particular C.V. from a ton of this coal.

Thus, assume it is required to find the yield of 450 B.Th.U. gas per ton of coal:

e.g., one ton of coal yields 13,000 c.ft. of gas at 550 B.Th.U.
+ "V" c.ft. of gas at 300 B.Th.U.

$$(13{,}000 \times 550) + (V \times 300) = (13{,}000 + V) \times 450$$

$$\therefore \quad V = \frac{13{,}000\,(550 - 450)}{450 - 300}$$

$$= 8{,}700 \text{ c.ft.}$$

i.e., the yield at 450 B.Th.U. should be approximately
13,000 + 8700 = 21,700 c.ft.
or 97·6 therms per ton of coal.

Having done this for each of the calorific values approximating to those actually obtained as averages in each test of the above steaming series, it is interesting to tabulate these against each other and to note how closely the theoretical and actual figures correspond. For this purpose the particular items concerned are abstracted from Table E and repeated herewith in Table F.

Both these sets of figures (Table F) are graphically represented in fig. 5 and indicate that from the point of view of gas-making, steaming under correct conditions represents an astonishingly true chemical reaction in which a very high efficiency can be obtained in industrial practice

TABLE F.

Results to be Expected from Theoretical Considerations and Calculations.			Results Actually Obtained in Industrial Scale Tests on Arley Coal.		
C.Ft.	C.V. B.Th.U. per C.Ft.	= Therms per Ton.	C.Ft.	C.V. B.Th.U. per C.Ft.	= Therms per Ton.
13,000	550	71·5	..	..	..
16,200	500	81·0	16,970	503	85·3
18,600	475	88·4	19,120	472	90·2
21,700	450	97·6	22,600	445	100·6
26,000	425	110·5	27,400	423	115·8
32,500	400	130·0	30,350	401	121·7
43,300	375	162·4	43,370	373	161·8
54,200	360	195·1	53,180	360	191·4
65,000	350	227·5	70,000	350	245·0
97,000	334	323·5	..	..	..

TABLE G.—*Arley Tests.*

RESEARCH GAS PLANT. STEAMING TO LIMIT.

ANALYSIS OF GAS MADE AND "ADDED" GAS.

(Averages of analyses of long period samples.)

Test	A	B	C	D	E	F	G
Steam used, p.ct. of coal	6	8	14	24	31	52	66
Gas made per ton, c.ft.	16,970	19,120	22,600	27,380	30,350	43,370	53,180
C.V., B.Th.U. per c.ft.	503	472	445	423	401	373	360
CO_2, p.ct.	1·4	1·2	2·7	3·2	4·3	5·0	4·0
O_2, ,,	0·2	0·1	0·2	0·2	0·6	0·3	0·2
C_nH_m, ,,	2·3	2·3	2·2	2·1	1·6	1·3	1·2
CO, ,,	13·0	14·1	20·5	21·6	25·2	28·9	31·2
CH_4, ,,	22·6	18·6	15·6	13·3	11·8	8·9	7·9
H_2, ,,	55·0	57·1	53·4	53·6	53·0	50·5	48·2
N_2, ,,	5·5	6·6	5·4	6·0	3·5	5·1	7·3
Total gas made per ton—							
CO_2, c.ft.	237	230	610	876	1,305	2,170	2,128
O_2, ,,	34	19	45	55	182	130	106
C_nH_m, ,,	390	439	497	575	486	564	638
CO, ,,	2,205	2,700	4,630	5,910	7,650	12,540	16,600
CH_4, ,,	3,830	3,560	3,527	3,641	3,585	3,860	4,200
H_2, ,,	9,340	10,910	12,070	14,680	16,080	21,900	25,650
N_2, ,,	934	1,262	1,221	1,643	1,062	2,210	3,880
Total gas made per ton additional to "A" by extra steaming—							
C.ft.	..	2,150	5,630	10,410	13,380	26,400	36,210
Consisting of—							
CO_2, c.ft.	..	− 7	373	639	1,068	1,933	1,891
O_2, ,,	..	− 15	11	21	148	96	72
C_nH_m, ,,	..	49	107	185	96	174	248
CO, ,,	..	495	2,425	3,705	5,445	10,335	14,395
CH_4, ,,	..	− 270	− 303	− 189	− 245	30	370
H_2, ,,	..	1,570	2,730	5,340	6,740	12,560	16,310
N_2, ,,	..	328	287	709	128	1,276	2,946
Calculated composition of "added" gas—							
CO_2, p.ct.	..	− 0·3	6·6	6·1	8·0	7·3	5·2
O_2, ,,	..	− 0·7	0·2	0·2	1·1	0·4	0·2
C_pH_m, ,,	..	2·3	1·9	1·8	0·7	0·7	0·7
CO, ,,	..	23·0	43·1	35·6	40·7	39·1	39·8
CH_4, ,,	..	−12·6	− 5·4	− 1·8	−1·8	0·1	1·0
H_2, ,,	..	73·0	48·5	51·3	50·4	47·6	45·0
N_2, ,,	..	15·3	5·1	6·8	1·0	4·8	8·1
Water gas, p.ct. of "added" gas (CO_2 + CO + H_2)	..	95·7	98·2	93·0	99·1	94·0	90·0
Calculated C.V., B.Th.U. per c.ft.	..	321	323	316	304	296	299
Corresponding equivalent of H_2O, p.ct. of coal	..	2·1	5·8	10·1	13·8	25·9	34·0
Additional p.ct. steam to retort (over "A")	..	2	8	18	25	46	60
Steam decomposed, p.ct.	..	100	72·5	56	55·2	56·3	56·7

at any stage in the process at which it is desired to stop.

With regard to the " added " gas, the accompanying Table G has been elaborated to show how the composition has been arrived at, and sufficient details have been recapitulated in order to make it self-explanatory. The majority of the calculated figures have been approximated only (slide-rule calculation), to an extent consistent with the degree of accuracy obtainable with the usual measuring plant and analytical processes.

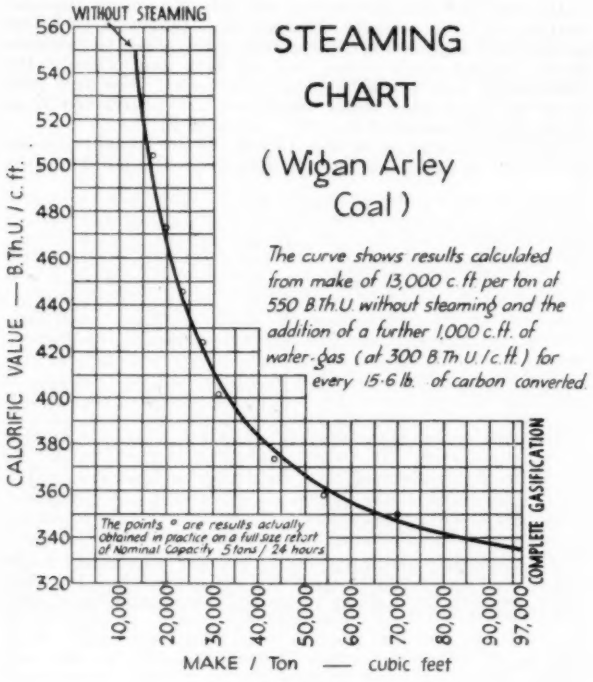

FIG. 5.

Apart from some slight discrepancies, particularly in the case of test B, which are rather difficult to explain, the results are of considerable interest.

The fairly uniform 6 or 7 per cent. of CO_2 in the added gas appears to be unavoidable and is, no doubt, due mainly to the lower temperature reaction of a portion of the steam in contact with the cooler coke at the centre of the charge in the retort even at the high temperature reaction zone.

There is also apparently about 6 per cent. of nitrogen produced attributable to any or all of 3 causes, viz., extra nitrogen swept out of the coke by the large volume of water gas made, nitrogen due to a little air entering the retort with the steam, and nitrogen from the air used for revivification *in situ* of the oxide in the purifying plant.

The other small items in the composition, alien to true water gas, may be due to any of the above causes as well as to the multiplied slight inaccuracies inseparable from even the best gas analysis apparatus and manipulation.

It will be observed that the calorific value of the " added " gas approximates closely enough to 300 B.Th.U. per cubic foot to justify the assumption made earlier, and another factor worthy of note is the close agreement (except in test B) of the $CO + CO_2$ with the H_2 figure.

Finally, it is shown that with proper control and adjustment of conditions from 55 per cent. to 75 per cent. of the steam passed into a modern continuous vertical retort, at any rate of the Glover-West " New Model " steaming type, may be converted into water gas.

Thus discounting the nitrogen, introduced as an alien element into the retort, the composition of the " added " gas or water gas produced during steaming in the retort, may be taken as approximately:

CO_2	7 p.ct.
CO	43 ,,
H_2	50 ,,
Cal. value	300 B.Th.U. per c.ft.

EFFECT OF STEAMING ON THE COKE.

The effect of steaming on the quality of the coke produced is a large question over which a considerable amount of controversy has raged.

With regard to the quantity of coke produced, this is a subject which can be dismissed in a few words. It is obvious that as steaming is increased so is the carbon content of the total residual coke steadily reduced (at the rate of 15·6 lb. of C. per 1000 cubic feet of water gas made) and the ash content of the resulting coke is correspondingly increased. This, however, is not completely true, as experience has shown that the steam does not react uniformly throughout each piece of coke. On the contrary, apparently only the outer layers of each piece of coke (or the fissure surfaces) are materially affected, the carbon being gasified and the ash constituents left in a fine skeleton or powdery form appearing mainly in the breeze, while the coke, especially after screening, is practically unchanged in value.

As showing the relatively small degree of deterioration in the coke, the ash content of the large coke (above 1 in.) in the above tests increased from 8·5 per cent. in test A to 17·6 per cent. in test G: the breeze (below ½ in.) calculated as a percentage of the total coke produced, increased from 8 per cent. in test A to 22 per cent. in test G, while the ash content of this breeze increased from 12·6 per cent. to 34·4 per cent. respectively.

Quantitatively, the yields of coke obtained in the above tests agree very closely, as would be expected, with the figures calculated from the above data.

Even the coke obtained in test H, while steaming to 350 B.Th.U. gas, was consumed freely and readily in the producer under ordinary conditions. The coke obtained in the production of gas of higher calorific value is a clean, dry, free-burning fuel and in each case was found to be quite suitable for use even under varying conditions as a domestic fuel.

FUEL CONSUMPTION FOR STEAMING.

The question of the extra fuel necessary in the steaming process for supplying externally the heat required for the water gas reaction has also been discussed, with much controversy, by previous investigators. It is interesting, however, to draw attention to the following figures indicating the heat available in the coke.

It has already been stated that the heat absorbed per 1,000 cubic feet of water gas made is approximately 65,000 B.Th.U.

One ton of coal produces, say, 1,500 lb. of red-hot coke in the retort.

Temperature drop in coke between production and discharge after steaming, say, from 1000° C. to 200° C.

= 1400° Fahr.
Sp. heat = 0·35 (approx.)

Heat available per ton of coal from coke in retort

= 1500 × 1400 × 0·35 B.Th.U.
= 735,000 B.Th.U.

i.e., sufficient for the production of nearly 11,300 cubic feet of water gas per ton of coal.

For a medium amount of steaming, therefore, it is doubtful whether there would be any appreciable increase in fuel consumption per ton of coal carbonized, the heat stored in the coke being sufficient to supply that absorbed in the water gas reaction. Actually in the Fuel Research Board tests (*supra*) the results showed:

Steam used p.ct. of coal carbonized	*Nil*	5·06	12·44	20·53	30·03
Therms per ton to carbonize coal .	16·07	10·64	16·11	20·0	23·83

i.e., it required less heat for carbonization with 5 per cent. steaming than with no steam, and no material increase of fuel was required until over 20 per cent. of steam was used.

For higher steaming it may be reckoned that, assuming the C.V. of coke as 12,000 B.Th.U. per lb. and a 30 per cent. efficiency as between the therms produced in the producer and the heat transferred to the charge (Willien, *supra*), it would require a maximum of 18 lb. of coke as fuel per 1,000 cubic feet of extra water gas generated in the retort.

No account has yet been taken here of the performance of the *waste-heat boiler*, an almost universal adjunct to any modern carbonizing system, by means of which 4 to 5 lb. of steam is readily made available, practically for nothing, for every pound of coke burned in the producer. There is thus available, with a 15 per cent. fuel consumption, steam to the extent of approximately 70 per cent. of the weight of coal carbonized. Expressed in another way, over one-half of the steam-raising capacity of the fuel consumed in the producer is realized and recovered in the waste-heat boiler.

The above figures with regard to coke and fuel have been purposely treated in a very cursory manner as it is realized that the value of and demand for coke and the relative values of coke and gaseous therms vary tremendously in different parts of the world. It thus becomes an individual problem in each locality to work out these ratios and the economics of the whole subject of steaming on the lines which have been indicated.

It must be realized, however, that such a high degree of

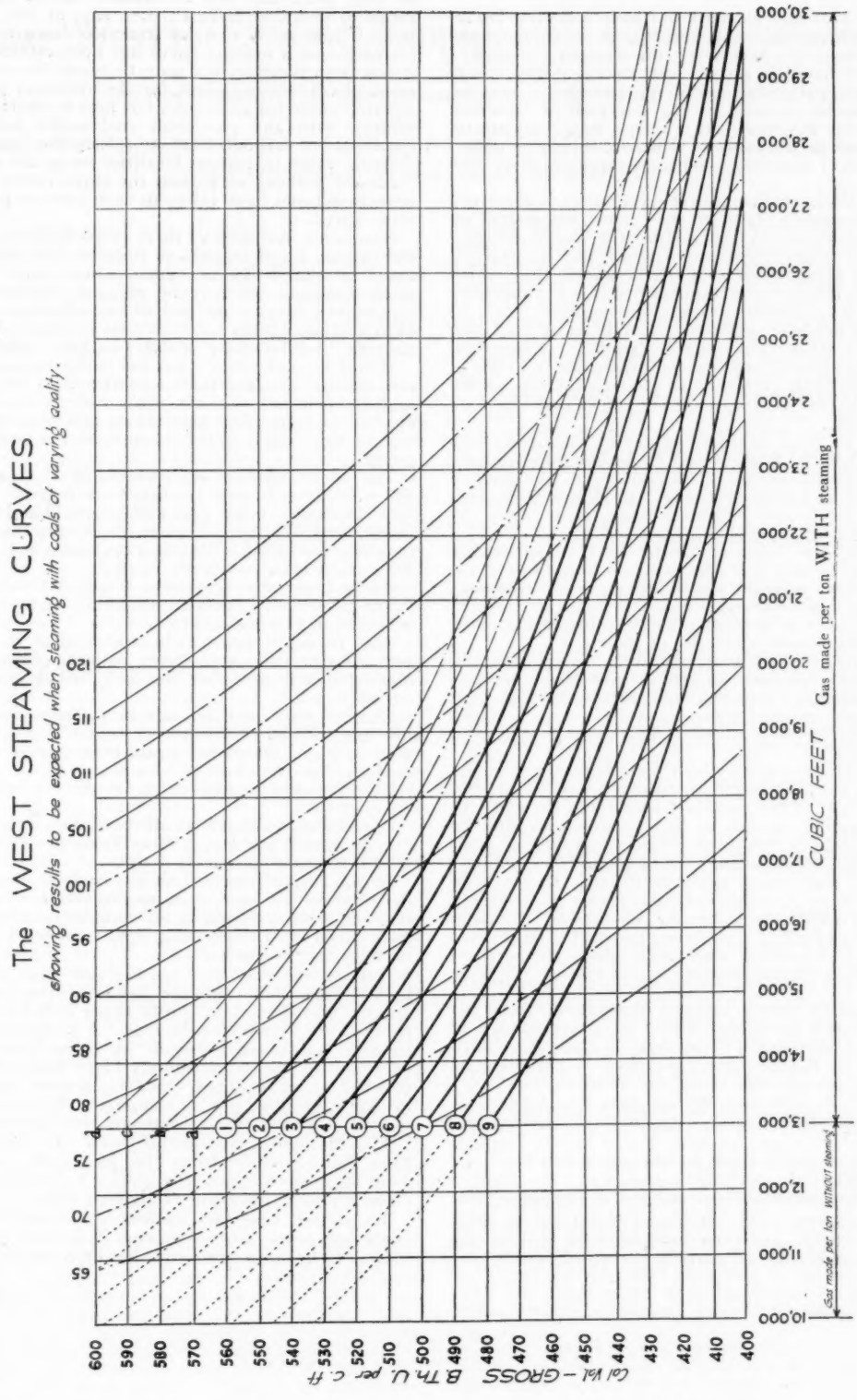

FIG. 6.

flexibility as is furnished by steaming is an invaluable adjunct in allowing of the attainment in the modern carbonizing plant of practically any desired variation in the quality of the gas. Deserving of even more consideration is the fact that there is here available a method of adjusting quantitative yields of gas and coke from the one plant according to the varying requirements of the local market.

In this connection, the question of *complete gasification* has already been seriously considered in cases where coke is difficult to dispose of, or for other reasons commands only a comparatively low price. Conditions may be so adjusted and steaming carried out to the extent of producing only sufficient coke for the fuel requirements of the retort setting. The question then also arises of a ready and economical method of *enriching* the gas produced, if below the standard quality required in the district. This problem, though still in its infancy, has also already been solved without having recourse to external plant. In one recent instance, an industrial carbonizing plant of continuous vertical retorts has been installed with special oil-cracking retorts, two to each bed of 8 carbonizing retorts, *heated by the waste-heat* of the setting. Each of these oil-cracking retorts is converting 100 gallons of oil per day into gas of 1,400 B.Th.U. per cubic foot with a yield of 1·1 ther ·s per gallon of oil.

THE WEST STEAMING CURVES.

Classification of Gas Coals.

Reference to fig. 5 will show that the curve represents the gaseous yield per ton obtained by steaming to any required calorific value from a coal giving 13,000 cubic feet

of gas at 550 B.Th.U. per cubic foot (*i.e.*, presumably without steaming).

It is obvious that any gas coal will have a similar curve of its own, which can be drawn out as soon as one point on the curve is known, not necessarily the straight gas yield.

On the other hand, a set of such curves having been constructed, the particular curve representing a certain coal can be selected as soon as any one yield is recorded from th plant for that coal. It is then a simple matter to forecast what the performance of that coal should be under the whole range of steaming conditions represented by the curves.

The use of these curves proves even more attractive, however, as affording a check on the correct adjustment of carbonizing conditions on the setting for any particular coal. Thus, if in two tests carried out on the coal at calorific values about 20 or 25 B.Th.U. apart, the results obtained do not fall on to the same curve, it is obvious that the carbonizing conditions (heats, throughput, and/or steaming) have not been adjusted correctly in at least one of the cases to obtain the optimum results. From this point of view the curves have proved invaluable in classifying available gas coals according to the best thermal yields obtainable under the varying calorific values demanded in different localities.

The original of these steaming curves was demonstrated in a paper read by F. J. West and T. A. Tomlinson before the Manchester Association of Engineers in November, 1920, on "Modern Developments in the Manufacture and Utilization of Coal Gas." (Proceedings, M/c. Assn. of Eng., 1920-21 (3), pp. 65-98.)

A more recent and more elaborate chart is reproduced herewith (fig. 6), which it is expected will be welcomed by all those connected with the gas industry, to whom steaming of coal is of any interest.

A few words of explanation may here be offered with regard to the construction and use of the curves.

The points 1, 2, 3——9 (corresponding to those on the original curves) represent imaginary first-class, second-class, third-class, &c., coals which on carbonization at high temperatures and *without steaming* would produce 13,000 cubic feet of gas per ton at 560 B.Th.U./cubic foot, 550, 540, &c., respectively.

Taking each of these points separately, equal increments of water gas at C.V. 300 B.Th.U./cubic foot are added, and the resultant C.V. of the mixture, calculated for each increment in a similar manner to that given previously; the curve passing through the resultant points is then plotted, and the process is repeated for each of the original points.

Since the original chart was constructed, it has been found that there are a number of coals giving considerably better gaseous yields than the one which was originally represented by curve 1 as a first-class gas coal. The curves *a*, *b*, *c*, *d* have, therefore, since been added to represent the particularly rich gas coals to which reference will be made later.

The chain-dotted curves running downwards from the top horizontal axis have been added as a convenience to give the therms per ton yield (gas make in cubic feet multiplied by C.V. in B.Th.U. per cubic foot and divided by 100,000) at any point on the chart, *i.e.*, from any coal.

A similar chart, with axes divided into the metric Continental equivalents has also been made available, *i.e.*, giving:

Volumes of gas in cubic metres per metric ton.
C.V. in Kg. Cals. per cubic metre, and
Thermal yields in millions of Kg. Cal. per metric ton.

Since the inception of the Research Gas Plant in Manchester (in 1923) it has been customary in testing the numerous gas coals from all parts of the world, which have been investigated, to carry out a series of at least 3 tests on each particular coal at calorific values varying over a range of about 50 B.Th.U., *i.e.*, say, at 500, 475, and 450 B.Th.U. per cubic foot, or from 450 down to 400, so that for each coal a definite curve has been established. Thus, it has been possible, not only to check the correct adjustment of carbonizing plant for the optimum yields at each calorific value for each coal, but also to estimate the possibilities, with any particular coal under normal modern conditions of carbonization, to satisfy the demands for any calorific value in various localities using the same coal.

Almost without exception, the three points have readily been found and have fallen in each case on practically the same curve.

Numerous examples of these could be given, but as each would only be of interest in isolated districts, in order to avoid a complicity of reproduction, only a few brief generalizations will here be given to indicate the results ascertained in this method of classification of gas coals. (For further details see "Results in Glover-West Vertical Retorts," published by W.G.I. Co., Ltd., 1930.)

It will be understood that the carbonizing conditions we are dealing with are those established as the best modern high temperature working of the continuous vertical retort specially adapted for steaming as indicated in the description of the "New Model" retort at the beginning of this paper.

The curve numbers refer to the West steaming chart—fig. 6. Curve 1 may be taken as representative of the best Durham coals; the well-known Lambton, Londonderry, and Wearmouth give results on this curve. The majority of the other Durham gas coals, as *e.g.*, Holmside, fall on and between curves 2 and 3.

Of the Lancashire gas coals, Wigan Arley, lying on curve 2, may be taken as representative of the best, while others lie between this and curve 4.

The Yorkshire coals include several of the best British gas-making coals, and these, as exemplified by Mitchell Main which is probably the best British gas coal, lie on curves *b* to 2.

The Somerset coals fall into two classes, those with fairly low ash content (below 10 per cent.) lie mainly on curves 2 to 5, while the poorer coals (ash content above 10 per cent.) range from curves 5 to 8.

The Welsh gas coals and the Scotch give results on curves 4 to 6.

It will thus be seen that all the British gas coals with the exception of a few outstanding Yorkshire coals are catered for by the original curves 1 to 9.

In the case of non-British gas coals an insufficient number of these has been examined to admit of a classification for each locality of origin, but numerous individual samples have given most interesting results, some of which may be usefully referred to here.

Outstanding examples are the rich coals of a later geological formation than the British coals, with very high volatile matter content (up to 42 per cent.) found in several parts of the American continent. A Chilean coal was found to give results on curve *d*. A Nova Scotian coal gave even better (and astonishingly high) figures corresponding to what would be about curve *h*. Several Australian coals are known to give similar comparatively outstanding yields of gas on steaming in continuous vertical retorts.

The European continental coals are relatively poorer than British coals from the gas yield point of view, ranging in most cases from curve 4 downwards, although there are some instances of higher yields.

We submit that this method of characterization of gas coals has much to recommend it from several points of view. In our own practice it has been found invaluable.

Gas for Hot Water Supply and General Heating

By E. L. Oughton, M.Inst.Gas E., Sales Superintendent to the South Suburban Gas Company

[Extract from a Paper presented to the Institution of Heating and Ventilating Engineers at the Swedenborg Hall, Hart Street, W.C. 1, on Wednesday, Jan. 6]

Storage Water Heaters.

The general classification of these heaters is the low-consumption types which have a maximum consumption governed to 10 c.ft., or 0·05 therm per hour, and a maintenance consumption of 2 c.ft., or 0·01 therm per hour, and the high-consumption types which are more elastic in consumptions ranging approximately between 30 to 200 c.ft., or 0·15 to 1·0 therm per hour.

The low gas rated type have quite a useful sphere of service, particularly in existing houses, blocks of flats, or offices where the gas supplies were laid before the advent of an almost universal appreciation of the advantage of gas for heating, and may be inadequate. In these circumstances a slow-heating storage system which does not require larger supply pipes being laid in, in many cases almost an impossibility and particularly where economy in installation costs is a consideration. These heaters, being automatic in action, heat up the water in the storage cylinder during the night ready for the early morning demand. Also, if fitted in a kitchen or scullery, an outside flue, which is sometimes difficult to arrange for, is not necessary, and is another point in favour of this type. The low-consumption type may also be fitted to existing hot water supply pipes, if of approved layout, and serve as an auxiliary system, though the higher rated type gives a more comparable service to the main coke-fired boiler.

The high-consumption type of heater has a very much wider range of service and adaptation than the low-rated type and will meet an emergency demand for large quantities of hot water, within, of course, the limits of the machine. However, an adequate gas supply and efficient flue arrangements are imperative.

Both types should be thermostatically controlled and may be fitted with safety cut-off valves, should the gas supply be intermittent, as when the gas is supplied through an automatic coin meter. While the range of utility varies greatly with these two types, it is very important to remember that the cost of gas per gallon of water heated is the same, except that the variation of thermal efficiency must be considered; but this is common to both types.

There are occasions where a gas circulating boiler may be advantageously used in connection with large central heating systems, with calorifiers for hot water supply. We had a case where a public hall and offices were fitted with a coke-fired boiler, with a calorifier, and it was found that it did not pay to run the boiler in the summer months, and the boiler house, as is generally the case, was too small even to fit a small coke boiler for summer duty. The problem was solved by fixing a gas circulator directly beneath the calorifier and making direct connections with Colman joints to the cylinder, to which the hot water supply pipe to the lavatory basins was connected, the valve on the heating circuit being closed.

Geysers and Multi-Point Heaters.

It is safe to say that where geysers are properly fixed—namely, with an adequate gas and water supply, and an efficient system of ventilation, which necessarily includes baffler and terminal of approved design and of correct size, and, if in a small bathroom, provision of fresh air inlets, we have the most efficient method of supplying large quantities of water at a moment's notice, within the limits of the machine. The only drawback to this method being that in many cases these provisions are either not made, or only partly available, in which cases other types should be fixed.

The ordinary geyser is a single point machine and has to be fixed over the bath, wash basin, or sink, &c., and gives a direct supply of hot water. Considerable improvements have been made in their construction of late, by means of the "Access" base, and vitreous enamel outer casing, so eliminating the earlier disabilities attendant upon the inaccessibility of the burner chamber.

Bafflers and terminals have reached a high degree of efficiency; the flue pipe may be connected with a loose sleeve enabling the machine to be taken down without disturbing the run of flue pipe, &c.

These water heaters are of the non-storage type and are designed to give the maximum rated supply of hot water upon demand. They are evolved from the single point geyser, but should be fixed in the kitchen or scullery so that the requisite head of water necessary to operate the automatic valves may be available. The hot water supply pipe is directly connected to the machine and run to the various taps. As there is no storage of hot water, no insulation is necessary. There is a small permanent pilot light and the full supply is only turned on when a tap is opened, and shut down when the tap is closed. In the latest type there is no condensation within the machine.

Coming within this class are machines constructed to deliver boiling water only for tea and coffee making. In hard water areas, it is most important to select designs which ensure low maintenance costs and simplicity in removing heating chamber for de-furring and fixing a spare one in its place. It is a decided advantage when this changing can be done by the user of the machine.

Bulk Supply of Hot Water.

This demand is generally for sports pavilions, bath houses, and trade uses, &c. There are three major conditions to be considered in deciding the type of gas boiler for this purpose—namely,

(*a*) Constant maximum demand.
(*b*) Known varying demand at regular periods.
(*c*) Irregular demand as to time and quantity.

(*a*) This is a simple case as the type of boiler is directly governed by the volume of water required and may be met by installing either one large unit or a battery of small units, connected in series to the storage cylinder which must be well insulated and thermostatically controlled.

(*b*) In this case, similar heating units as in (*a*) may be installed, probably the battery of small units grouped to meet the maximum and minimum demands, and connected to storage cylinder with cut-out valve, or to separate cylinders which would be suitably lagged and thermostatically controlled.

(*c*) These conditions may be met by installing heating units capable of meeting the maximum demand, and being thermostatically controlled would shut down when the demand temporarily ceased, the lagged storage cylinder being also of sufficient capacity to meet a sudden demand, having been heated up during the periods of low demand.

Gas-Fired Boilers for Central Heating—Hot Water.

Recent developments in the design of gas boilers for central heating systems has given an extended field for the use of gas, though, of course, for many years gas-heated installations have been used for this purpose to a limited extent.

The following are some of the factors operating towards the greater use of gas: (*a*) More compact and efficient units; (*b*) elimination of the human factor in operation and control; (*c*) efficient remote thermostatic control; (*d*) no ancillary motive power necessary for ordinary installations; and (*e*) independent units in factories and business premises, where rooms are sublet to various trades and requirements.

There are, however, systems by which increased efficiencies of 90 p.ct. to 95 p.ct. are obtained by the use of motor driven fans or compressors and which meet definite demands of the heating engineer.

As the load factor in many installations may vary from 30 p.ct. to 60 p.ct. special consideration should be given to the insulation of mains, and remote room control should always be installed wherever possible if advantage is to be taken of the load factor as regards reducing costs.

The beneficial effect of gas lighting in churches and public halls is often overlooked—until it has been displaced by electric lighting, when complaints arise regarding severe down-draughts never before experienced. To overcome these draughts, three courses are open—namely, (*a*) reinstate gas lighting fittings for the main lighting; (*b*) fix flat flame gas burners high up in roof; (*c*) run an auxiliary heating main round upper part of building. For economy and efficiency surely the method (*a*) is the best, as it supplies light and ventilation for the one cost. The

heat generated is never oppressive, when the gas burners are fixed directly to or below the outlet ventilating shafts.

Central Heating by Warm Air.

There are indications that the warm air method of central heating is attracting considerable attention at the present time, owing to the increased efficiency of the latest types of gas-fired furnaces.

The advantage of the gas-heated units may be summed up as the absolute simplicity with reliability in operation and sensibility under automatic control. The thermal efficiencies are also of a high order, ranging in use from 60 p.ct. to 80 p.ct. In the event of the fan stopping from any cause, it is usual to fix a cut-out valve which cuts off the gas supply and so prevents overheating in the heater itself. This principle of heating has a wide range of utility, as it may be applied to private houses, suites of offices, churches, and public halls.

Industrially, it is largely used for heating ovens where even temperatures are imperative, as in enamelling and kindred trades, case-drying, varnished paper drying, whether of the stationary or conveyor type of oven.

Gas-Fired Unit Heaters.

The unit heater is not a new method of heating factories, warehouses, and similar buildings by the medium of warm air, they having been largely used with steam-heated units.

The application of town gas is, however, comparatively new to this country and installations actually in use are proving very satisfactory. The great advantage of this system is that the warmed air is directed as and where desired, and gives an immediate sense of warmth. Another point in its favour is the facility for use, with the gas turned off, as a cooling agent in hot weather. The unit operates automatically when the motor driving the fan is switched on. The gas consumption per unit full on is 0·9 therm per hour, and the output of warmed air raised through 45° Fahr. is 1500 c.ft. per minute. An all-in efficiency of about 75 p.ct. is obtained. The operation of the heater is as follows: The motor driven fan, which is an integral part of the unit, causes the air to pass over the heated flueways and directs the warmed air in a downward direction, through adjustable louvres. The permanent pilot light is fitted with a safety cut-off device which operates by shutting off the main gas supply if the pilot should not be lighted from any cause.

In addition to the foregoing methods of warming air for a central heated unit, there are methods in which independent heating and ventilating units are used either as auxiliary sources of heat or as a complete scheme. In this system, the air is warmed as it is drawn in from the outside, and is passed through a panel type of heater, which is fixed to the outer walls or connected thereto by a suitable duct. The heating unit consists of luminous flames which heat the incoming air as it passes through and out into the room through a series of louvres. The gas burners are governed to consume about 8 c.ft. or 0·04 therm per hour and may be controlled thermostatically. The volume of incoming air is governed by a damper, and the quantity of air heated is about 1000 c.ft. per hour. The surface temperature of the heater is 140° Fahr. and 160° Fahr. maximum with the damper open or shut respectively. The efficiency in operation is approximately 85 p.ct.

Boilers for Steam Generation.

There are many circumstances where gas-fired steam boilers are a definite advantage as well as a necessity when consideration of space, absolute cleanliness, intermittent demand, and automatic control, with real flexibility in operation are essential. Small units for large kitchen steamers, water boiling for tea, &c., steam-heated presses for clothes are in almost universal use. An increasing use for these boilers is found in many industries where special process work demands a comparatively small amount of steam at a higher pressure, perhaps, than the large coke-fired boiler gives, and to increase this pressure would not be economical—*e.g.*, moulding presses for bakelite, casine and similar products, in which case a compact layout with a closed circuit is both efficient and economical. This is only one of many uses. Again where a process has a varying or low load factor, the automatic control of gas in the "off" periods makes the gas-fired boiler a necessity if economy is appreciated. Gas-fired steam boilers are also used for air conditioning plants in connection with heating and ventilating installations in cinemas and public halls.

A recent installation we had will show the utility of gas for central heating. The factory in question required a definite temperature of 60° Fahr. plus and minus 3° Fahr. winter and summer, and the heating system was fixed in conjunction with a cooling system of a battery of pipes in which brine was circulated during the summer months when the temperature outside was about 60° Fahr. When the outside temperature was lower, the gas boiler being automatically controlled heated up the piping which was arranged in suitable positions on the walls, the temperature being controlled by an air thermostat fixed in the room. Owing to the necessity of having sufficient heating surface to meet the coldest weather possible, a greater heating surface was provided than under ordinary conditions. This involved a larger heating boiler, but as the temperature control is efficient the boiler responds readily for any weather condition, and no unnecessary waste of fuel takes place. This installation has given every satisfaction in respect of temperature control and cost.

Another interesting installation is one where steam is required for sterilizing vats of over 2000 gallons, boiling up liquids in 900-gallon pans, steaming barrels, and heating up the factory building. The gas-fired boiler had a maximum output of 1400 lbs. of steam from and at 212° Fahr. and a maximum gas consumption of 15 therms per hour. The boiler is thermostatically controlled according to the demand for steam and the gas consumption varies accordingly. The average working efficiency of the boiler is 75 p.ct. to 80 p.ct.

Types of Gas-Fired Boilers.

A new type of sectional boiler consists of 4, 6, or 8 sections built together, having an output of 76,500, 127,500, and 178,500 B.Th.U. respectively. The four-section heating unit consists of two internal tubular heaters 9 in. long and 5 in. diameter with a gas consumption of 0·9 therm per hour. Air is supplied under pressure by a motor-driven fan of very low horse-power. Thermostatic control is fitted and operates so as to break or make the circuit to the fan when the required temperature of the water is attained, or falls to the low temperature limit, and so automatically shuts off or opens up the air supply and likewise controls the gas supply through the medium of the diaphragm control. A thermal efficiency of 85 p.ct. is claimed.

Another compact type of sectional boiler with enamelled case and well insulated has pin-head studs on the flame side of the heating sections, and is heated by luminous flame burners fitted with a governor to maintain rated consumption. Thermostatic control is effected by a relay type thermostat. Low-pressure gas is used. Another boiler for central heating is also of the sectional type, the units being placed side by side and connected as one unit. The flames are not luminous and are controlled by a governor. The thermostatic control is by means of a bi-metallic strip. There is no pilot light but a permanent by-pass which is adjustable according to requirements.

Gas Fires.

In general terms the gas fire serves a dual purpose—(*a*) as self-contained units for local heating of rooms, and (*b*) as supplementary heating units to a central heating system.

It is not necessary to enlarge upon the advantage of an ordinary modern gas fire as a source of radiant energy with a varying degree of convected heat, in addition to the effective ventilation it produces as a single heating unit in any room with a chimney or facilities for running a suitable flue. When used as auxiliary units to central heating, they serve to supplement the heat in colder weather, or allow a lower temperature heat emission from radiators and so a less degree of heating of the air, and at the same time effect the very necessary ventilation of the room together with the increased comfort associated with a glowing fire. Of course, where there is not central heating, the use of flueless gas radiators in the hall and landings of the house do enable warmed air to be drawn into the room and so add to creature comfort by eliminating to some extent cold draughts. The warming and ventilating effect of gas lighting acts somewhat similarly and gives perceptible warmth in the house. It is also obvious to the heating engineer that controlled fresh air inlets in the rooms prevent the indiscriminate drawing in of air through any opening or crevice.

Any type of modern gas fire, if of the size necessary for heating the particular type of room in which it is fitted, will give the necessary change of air consistent with healthy conditions. There are fires which are designed to give an increased percentage of convected heat by passing air from the room up behind the fire brick and warmed before passing into the room above the canopy. An advantage of this extra small amount of warmed air projected into the room is that a comfortable state is achieved more quickly than when dependent upon the secondary convection air currents from walls and furniture heated primarily by direct radiation.

As with gas fires, there are many different designs of radiators, with and without flues, suitable for any type of house or public building, workshops, and garages. The gas burners are all governed and many are thermostati-

cally controlled. In private houses, gas radiators are ideal as ancillary means of heating halls, corridors, and large rooms, in the absence of central heating or gas lighting.

[Mr. Oughton's paper was illustrated by a number of interesting lantern slides showing typical examples of the gas appliances dealt with in his paper, together with diagrammatic illustrations of their internal mechanism.]

Discussion.

The CHAIRMAN (Mr. Flemming Browne), opening the discussion, referred to the great advances made in gas appliances during the past 10 or 15 years, and he was sure that most of those present used gas for one purpose or another. One complaint he had with a gas appliance was that his bathroom geyser left a rusty stain on the bath.

Mr. OUGHTON remarked that this was a local fault, and modern geysers did not do this.

Mr. T. F. C. POTTERTON congratulated Mr. Oughton on his paper; he had put forward a very good statement, he remarked, in support of the valuable services which gas rendered to the public.

Mr. ALEWYN A. JONES also added his congratulations on the paper. He felt that during the last few years the Gas Industry had been adopting every possible device in order to utilize gas for central heating and hot water supply. It would be a surprise to some to see the numerous types of apparatus which had been developed for these services. He was of opinion that the Gas Industry had adopted something which heating engineers ought to have adopted more readily some time ago—namely, the matter of insulation of appliances. Gas appliance manufacturers and gas undertakings provided this on almost every piece of apparatus. Another important thing the Gas Industry had done was to go into the question of heat loss from pipes from different kinds of paints, and they had now adopted aluminium paint as being the best method of reducing this heat loss.

A QUESTION OF COST.

Mr. J. W. COOLING thanked the author for his address, and said that there was one point that struck him in regard to the question of fuels for heating purposes—and that was the cost of gas. He did not know the general price of gas, but it seemed to him to be fairly high as a fuel, and until the Industry was able to lower the price he did not see how it could compete with oil and coke. Many undertakings, he said, allowed rebates for large consumptions; but even so they could not compete with other fuels. Gas was the ideal fuel for heating engineers, and if only the cost could be brought down, the Gas Industry would have to go on building extensions at its works for many years to come.

He went on to inquire if the gas-fired unit heater referred to in the paper was a commercial product or whether it was still in the experimental stage; also if any care was taken to dispose of the products of combustion from the apparatus, as these might be dangerous in some circumstances. He had heard the complaint in connection with gas boilers that a good deal of waste went on if the thermostat came into operation owing to the flue being open, and also in regard to the amount of gas consumed by the pilot jet. He asked if any steps were being taken to reduce this waste. He was particularly interested in the question of gas lighting as an additional aid to both heating and ventilation.

Mr. S. ADAMS (Gas Light and Coke Company) spoke upon the subject of individual room control for central heating. This was such an easy matter to include in any installation that he thought it should be adopted more extensively. Another point was the question of a boiler house. In London, especially, space was very valuable, and it was often not possible to devote, perhaps, a whole basement room to this purpose. His Company had fitted a number of boilers on the roofs of premises, and this was an important point to further the use of gas. An accelerator on the flow and return system was, of course, necessary in such cases, but the cost of the motor was repaid by the saving of space. Most gas undertakings, he concluded, were now giving discounts for gas used for such purposes as central heating, while one large undertaking adopted a discount for all gas over a certain figure for any purpose, so that the central heating consumption was included.

Mr. S. McJ. SAUNDERS said he was glad to see what the Gas Industry had to offer in the way of supplementary heating to the coke heating systems. This was particularly valuable in summer time.

"LARGE" INSTALLATIONS.

Mr. E. B. DARBY questioned Mr. Oughton's reference to what he termed "large" installations. He hardly thought that gas could be applied to what they considered a really large installation; in such circumstances the floor space occupied by the gas boilers would be far greater than that necessary for the ordinary steam heating apparatus. Some few years ago a form of gas-heated calorifier was put on the market, which he remember as being very successful. The gas was fired by means of a sparking plug in the combustion chamber. This apparatus had disappeared, however, in recent years, and he asked if Mr. Oughton knew anything of it.

Mr. TORRY remarked that Mr. Oughton had put forward the case for gas very well indeed, and as a gas man himself he wished to thank him. A speaker had just mentioned the unit heater. He knew of a case where seven of these heaters had been installed eighteen months ago, and they had operated for two seasons very successfully indeed. The method of heating was as follows: The products of combustion travelled from the burners through a series of tubes; an electrically-operated fan drove air over the surface of these tubes, thus warming it. The products of combustion were subsequently carried to the outer air. The installation he was referring to was on the fifth floor, and it gave comfortable working conditions within twenty minutes of being lighted up. Another aspect of gas utility, which would come more and more to the fore in the near future, was in the model dwellings of to-day. There were many thousands of houses in London which had no bathrooms, and many owners were having them put in. In cases such as these the ordinary gas copper could serve two purposes—on Mondays it could be utilized for the weekly wash; and then, by means of a special valve, it could be switched over to bath water heating over a distance of anything up to 50 ft., giving an 18-gallon bath at 110° Fahr. He knew of many estates where this was now being done.

LABOUR SAVING.

The point to be remembered, he concluded, was the labour saving of gas boilers, particularly where there was automatic control. Gas undertakings also supplied coke, so that when the gas was too dear for the purpose coke could be used in its place. In the latest systems thermostatic control could be adopted with coke boilers, and there was a big future here in competition with oil.

Mr. POWELL said that Mr. Cooling had touched upon the most important question regarding unit heaters; for they were ventilating engineers as well as heating engineers. Another matter was in regard to the calorific value of the gas supplied. It appeared to vary from 350 to 560 B.Th.U., and it seemed to him that this did not apply to London alone, but also to provincial towns. He would like to ask Mr. Oughton the approximate calorific value of London gas.

Mr. T. G. NOBLE (Gas Light and Coke Company) remarked that he had been hoping that Mr. C. A. Masterman, of Watson House, would have been able to be present on that occasion, but unfortunately this had not been possible. He thought that those who had not realized before would now realize the variety of uses to which gas could be put in their service. The advantages of flexibility and cleanliness with which they were familiar had also been stressed. Mr. Oughton had suggested that the consumers should be left to maintain their own appliances. Mr. Noble felt that this was not a good scheme, for, once they let the consumer start pulling appliances to pieces, one never knew where they would stop. The point Mr. Oughton had made about spring taps, he continued, was important. They often found that low-consumption storage heaters, stated to be inadequate, were in reality quite adequate for their purpose.

FLUE EQUIPMENT.

The importance of good flue equipment, went on Mr. Noble, had also been emphasized by Mr. Oughton. It was now really unnecessary to emphasize this to an Institution such as theirs, but there were just one or two points in regard to flue equipment which should be noted, particularly having regard to Mr. Oughton's remarks about "approved designs." There were, as a matter of fact, a number of bafflers on the market at the present time which would not fulfil their purpose. Another point which it seemed to him was of value was the fact that the boiler for gas central heating installations was such that it could perfectly well be installed in a living room. Space was restricted in many houses, and a coke boiler could not be fitted in a living room. In conclusion, he remarked that if any of them were in any doubt as to methods of fixing gas appliances or required any information, his own Company, or any other gas undertaking, he was sure, would be only too pleased to help them.

THE AUTHOR'S REPLY.

Mr. OUGHTON, replying to points raised in the course of the discussion, said he had been interested in the point mentioned by Mr. Jones in regard to heat losses. The Gas Industry had recognized the importance of this matter, because they were the first to admit the high price of gas as a fuel. They contended, however, that there were definite circumstances where the advantages associated with gas made it a good proposition. With this in mind they had to take every possible care, by means of insulation, to prevent any needless loss.

Replying to Mr. Cooling, he said that there were certain jobs of considerable size in the way of gas central heating installations, and he went on to give examples supporting this statement. His Company were now giving a discount price for central heating. In regard to the matter of loss referred to by one speaker, in their modern apparatus they cut right down to the pilot light, and even in the biggest boilers the pilot only consumed some 1 to 2 c.ft. of gas per hour. So there was not a great deal of loss with good insulation and thermostatic control.

The matter of room control had been mentioned by Mr. Adams. This was a question of load factor, and room control certainly did give full appreciation to this, having the effect of making gas a good proposition, even to rendering it comparable in price with coke. In regard to the unit heater, he understood there were several instances where these heaters had been fixed and were giving satisfactory use. In most cases they should be fitted with flues; though he could conceive a case when, with a very high building, the products could be discharged into the upper strata, and a flue might not be absolutely essential. Nevertheless flues were desirable with these appliances.

The gas copper, continued Mr. Oughton, was good if one could

not have a storage system. It was largely a question of efficiency with these appliances, it being probable that a figure of more than 60 p.ct. could not be obtained.

THE VALUE OF LONDON'S GAS.

In reply to the question regarding the varying calorific values of London gas, there were values of 475, 500, and 560 B.Th.U., 500 being about the average. There was, of course, 12½ p.ct. more heat in the 560 B.Th.U. gas. Replying to Mr. Noble, he also believed that gas appliances should not be interfered with by consumers; this was a job for a trained man only, and every gas undertaking should have a maintenance system for all appliances whether they were consumers' property or on hire. In regard to the bafflers and terminals, the former were fitted in order that downdraught should not extinguish the flame in the gas appliance. The terminal helped that by preventing, as far as possible, the downdraught in the first instance. The Ventile was a satisfactory terminal which seemed to meet cases which no other type could meet.

The meeting closed with a hearty vote of thanks being passed to Mr. Oughton for his paper, to which he briefly responded.

Wales and Monmouthshire Junior Gas Association

The third meeting of the session was held at the Gas Offices, Cardiff, on Saturday, Dec. 19, 1931, when the President, Mr. S. E. BRETT, occupied the chair.

Two new members were welcomed to the meeting—Messrs. B. Davies (Cardiff) and W. N. Little, Associate Member (Cardiff).

The Hon. Secretary, Mr. H. S. Bartlett, gave a short report of the proceedings of the British Junior Joint Council meeting held in Leeds.

VIEWPOINTS ON THE GAS INDUSTRY.

By R. R. BROWN, of the Cardiff Gas Light and Coke Company.

[EXTRACT.]

ADVERTISING.

The showroom should be the pulse of the service department. A bright, well-illuminated showroom is a great asset and indispensable for the success of any particular undertaking. Modern exhibitions of complete domestic installations such as a model kitchen and kitchenette should be shown periodically; besides the formation of a woman's advisory section, to give general information and a series of cooking lessons, which consumers could be invited to attend.

However, advertising does not end at the showroom. Our Industry is fortunate in having an open door to its consumers. Complaints, perhaps, afford the greatest means for building new business. Gasfitters and outdoor workmen have exceptional opportunities of effecting sales, being brought into touch with consumers in their ordinary employment. While immediate purchases may not be recorded, experience shows that a good percentage of orders for gas appliances are the outcome of those confidential talks between consumers and outdoor employees.

While I do not advocate house to house canvassing, we should make an inspection of all our consumers' fittings at least once a year and advise where the use of gas could be extended advantageously to both consumer and gas undertaking; besides repairing any small surface defect on consumers' fittings free of charge.

TARIFFS.

Tariffs form a big part in the electrical equipment. They have an amazing range of charges for power, heat, and light, which are sounder in word than in effect; they also have their free wiring, assisted wiring, &c. To combat this form of competition, we must urge the necessity of obtaining the power to make special prices for the supply of gas for various appliances ourselves.

The fixing of appliances, free of charge and the maintaining of them in perfect working order at a low quarterly rental, commonly known as simple-hire, is very popular with the artisan class; and, providing the appliance fixed is serviceable and fairly economical, there is little risk of having to take it out. Overhead charges, as far as finances permit, must be reduced to a minimum; a valuable percentage of orders are lost in this way. We must to ensure success lay down no hard and fast rules with regard to prices for fixing appliances; but allow our salesmen to use their own discretion when dealing with each potential customer.

In considering appliances, full credit must be given to the manufacturers for the continuous improvement which has been made in the design, finish, utility, appearance, and efficiency in use of the many forms of apparatus, whether for lighting, cooking, heating, or any other purpose. One of the most outstanding developments in domestic gas appliances is the increased employment of enamelled surface.

LIGHTING.

We can ascertain how near the light from incandescent gas, or any other form of light, approaches daylight by using a spectrophotometer, or by photographing the spectrum. The first method is undoubtedly the easiest, and the most convenient form of making optical comparisons of the gas light spectrum.

Turning to the practical side of gas lighting, this products of combustion question is also important in the realm of lighting. We are still searching for the "perfect" burner which will be constructed of some substance which will be impervious to the action of the products of combustion; will not become discoloured and will emit at the point of ignition such a mixture that shall be completely consumed, and thereby reduce the necessity for adjustment and maintenance to the minimum.

The principle of multiple small mantles on a superheater burner with single gas and air control strongly recommends itself. Several local elementary schools use this form of lighting, with suitable reflectors to direct the light. It is found that the fittings give out 50 p.ct. more light, and the extra strength of the small mantles means less frequent renewals.

Reflection of light to improve the light emitted is the next consideration. Reflectors of the metal type generally suffer from two faults—they become twisted during cleaning operations, and eventually become discoloured through the action of the products of combustion. The use of mirrors as reflectors and distributors of light is sometimes right, sometimes wrong; it is wrong if it permits the image of the light to be at all prominent in the field of vision. It will be right if the brightness of the reflected light be so reduced at its source by diffusing media as to render any reflection innocuous. Holophane and enamel shades are very little affected by the action of the products of combustion, and in my opinion offer the best medium for reflecting light.

Wall brackets should be provided with adjustable reflectors, so that the light can be directed where it is most needed. We can extend our sales by floodlighting of hoardings and buildings, as in some cases gas is much cheaper than electricity for special lighting.

GAS COOKING.

Again, improvements have been made in efficiency, cleanliness, and reduced gas consumption. Conservation of heat by more lagging; lower water equivalent of iron; automatic devices for controlling the oven heat; and the use of special flues, with the outlet at the bottom of the stove, are the keynotes of improvements in manufacture.

The gas cooker has an advantage over the electrical cooker in the ease with which the temperature can be regulated. The best that can be done with an electric cooker is to provide two or three heats by switching off one or two sections of the heating element. This is not to be compared with the fine adjustment which can be attained by the use of the gas tap, or, better still, by the automatic controllers. Good cooks like to have the oven temperature under fine control. Flue connections to gas cookers are unnecessary where there is adequate ventilation; because the products of combustion are, for the main part, no more than carbon dioxide and water vapour, and contain no bacteria. In cafés and big kitchens however a large flue hood should be fixed over the gas cooker, or cookers, to take away the hotplate products of food frying, grilling, &c. To my mind, a little improvement could be made in the hotplate design of a gas cooker by substituting for the cast-iron section top bars an enamelled steel hotplate having circular sections cut out for the usual hotplate burners, while providing enamelled steel covers to cover up the holes when not in use, thus forming an all-enamel hotplate. In addition, removable iron supports for the cooking utensils to prevent the flame from impinging against the enamel sides would have to be made. This would not only add to the appearance of the gas cooker but would eliminate the choking up, with fat, water, and other food material of the hotplate burners, which cause incomplete

combustion, offensive odours, and rapid corrosion of the hotplate components.

Heating Stoves.

The use of radiant heat in this country seems to have been greatly increased in the last few years. The modern gas fire is the outcome of tests and experiments to increase the heat emitted as well as to improve its ventilating effect. First of all, fuel radiants were standardized to a great extent, and their composition was modified to improve the quality of the energy given out by the gas fire. The radiant produced more light and gave greater comfort with less scorching effect.

An improvement in gas fire construction, which is very slow in adoption, is a galvanized steel heater, or flue box, which can be fixed to any gas fire by means of special clips. This heater prevents all the valuable heat from going up the chimney, besides drawing in all the cold air from the room; and distributing warm fresh air from the airways that extend the whole length of each side of the stove in addition to the usual heat obtained. Other improvements are portable gas fires, screen heaters, portable pedestal bowl heaters, gas fires with no projecting trivet or fender, and panel heaters, a new and improved type of radiator taking up practically no space, which can be fixed upon a wall at any convenient height.

Water Heating.

We can undoubtedly secure a new field for gas in the direction of water heating by surface combustion water heaters. Surface combustion consists in bringing a combustible mixture of gas and air in suitable proportions into contact with the interstices of an incandescent porous solid of suitable condition and porosity, in such a manner as to produce a flameless, or as nearly as may be flameless, surface whereby the porous solid shall be maintained in a continuous state of incandescence. The incandescent material may be in the form of a diaphragm, or of a granular bed, which need not be deep. The first is applied to the boiling of water, evaporation or concentration of liquids, &c., and the second to high-temperature processes such as melting metals. The process has been adopted to steam boilers and there is scarcely any large heating operation to which it is not capable of application. With this process it is possible to use a self-contained mixture—*i.e.*, gas mixed with the full complement of air required for complete combustion.

Instantaneous, flueless water heaters with low by-pass consumption, giving a continuous unlimited flow of water, and at a temperature controlled at will by the user at the draw-off tap, are becoming increasingly popular. Small consumption burners fixed under existing back boilers provide a cheap and efficient means of supplying hot water in summer, when the kitchen fire is not needed.

Gas for Industry.

In considering the place of gas in the industrial field it should be recognized that its chief usefulness will be more in the direction of supplying the manifold wants of innumerable, but relatively small, consumers than in meeting the demand of larger establishments, whom it will probably always pay to generate their own gaseous fuel.

The applications of gas to metal work are in connection with aluminium, brass, and various alloys, which are melted in gas-fired crucible furnaces. Special steels (including tool steels) are hardened, tempered, and annealed by the same method. The printing of a newspaper of large circulation requires a continuous supply of molten type metal, and gas is very applicable for this purpose. Another extending use for gas is the heating of japanning ovens and the like.

Gas can be largely used in connection with the different heats required in the manufacture of glassware, and also in the textile industries.

To increase further the use of gas for industrial purposes, we must provide consumers' premises with gas at constant pressure, and also, equally important, at a wide range of pressures at command. This can only be brought about by the increased use of high-pressure primary mains, having governors placed at the place of consumption.

In conclusion, I would just mention the use of gas as a motor fuel. During the war, owing to the shortage of motor spirit, gas was used for the running of motor-buses and all covered motor vehicles. In Paris a scheme is progressing for using gas cylinders instead of petrol tanks on several of the municipal buses. So far the use of gas is only practical for heavy vehicles; the difficulty experienced with small cars is the weight of the steel cylinders.

Discussion.

Mr. C. S. Thane (Newport), in congratulating Mr. Brown on his paper, said he was especially interested in the possibilities of the use of gas for motor vehicles.

Mr. Rees (Neath) said that recently a method had been found by which motor-spirit could be manufactured much cheaper; and that rather limited the possibilities of gas in this direction.

Mr. Brown stated that neither process as yet had proved a commercial proposition, and that while only in its infancy experts were of the opinion that the outlook of gas as a motor fuel was distinctly bright.

Mr. Williams (Cardiff) believed that the flue outlet of gas cookers should be taken outside. Also, in laying high-pressure mains he argued that the cost would be the same as low-pressure mains for the same capacity, owing to the high cost of steel.

Mr. Brown, in reply, pointed out that in the modern scullery or kitchenette there were at least two doors and a window. One door leading into the kitchen and the other being the back entrance to the house, thus providing plenty of ventilation, and the speedy transference of products of combustion into the atmosphere, without disfiguring walls and fixing unsightly pipes. Besides, the average person emitted about 0·8 c.ft. of CO_2 an hour through respiration and with it harmful organisms, whereas when the CO_2 was the result of combustion, it was pure and had no effect on the atmosphere of the room unless in very large proportions—say, 50 volumes of CO_2 to 10,000 volumes of air. The sulphur content was very minute and was readily absorbed by the walls and ceiling.

Mr. Mills (Cardiff) said that the maintenance of enamel and the increased adjustments necessary with the old types of gas appliances put the balance against simple hire.

Mr. Brown, replying, referred to the policy of the electrical industry. If they could place high-grade enamelled appliances on simple hire, with the present high cost of electricity and renewals, surely the Gas Industry could adopt a more aggressive policy in this respect with great success. In reply to Mr. Williams as to the cost of laying high-pressure mains, Mr. Brown stated that much was based on the equality between the cost of compression and the saving on mains and whether the area to be supplied was a scattered one or a small, thickly populated area. For a rough calculation, he estimated that taking a length of main, say, 4000 yards, the cost of mainlaying was—Low-pressure, 6 in., 6s. 6d. per yard; high-pressure, 5 lbs. drop to ½ lb., 2 in., 2s. 6d. per yard—a saving of 4s. a yard on high-pressure distribution. This made the price of steel a minor consideration.

Mr. Cruise (Cardiff) agreed with Mr. Brown that they had yet to find the domestic burner that would be impervious to the action of the products of combustion. He had found, however, with regard to gas for industrial purposes, that supplying gas for large uses was most applicable and not for the numerous small uses, as suggested by Mr. Brown.

Mr. Brown contended that, taking Great Britain as a whole, there were greater opportunities for the increased use of gas for small purposes, steam raising, &c., than for larger uses where it would almost always pay an undertaking to make its own.

Others who took part in the discussion included Mr. B. J. Bell (Cardiff), Mr. L. Cox (Cardiff), and Mr. N. L. Skinner (Cardiff).

The Senior Vice-President (Mr. C. S. Thane) then proposed a vote of thanks to Mr. Brown. Mr. D. W. Rees seconded. and it was carried unanimously, Mr. R. R. Brown suitably responding.

Technical Development in B.T.H. Equipment.

Many technical developments of importance may be noted for the year 1931, and it is of interest to refer briefly to a few contracts as indicating the continued development in design and performance of the comprehensive range of electrical equipment manufactured by the British Thomson Houston Company, Ltd., of Rugby.

An important order was received by the firm during the year from the Gas Light and Coke Company for equipment to be installed in a new booster house at the Beckton Gas-Works. This equipment comprises six turbine-driven gas boosters, three of a capacity of 3 million and three of 2 million c.ft. per hour.

An order for two turbine-driven gas exhausters has been received from the Woodall-Duckham Vertical Retort and Oven Construction Company (1920), Ltd., of London, who are supplying coke oven plant for the South African Iron and Steel Industrial Corporation, Ltd., of Pretoria, South Africa. Each exhauster will be designed for a maximum output of 14,000 c.ft. per minute at 2½ lbs. per sq. in. gauge delivery pressure.

An order is in hand for a 10,000 c.ft. per minute turbine-driven blast furnace blower incorporating the B.T.H. patent design of constant volume governor.

During the year two large compressors have been completed and put into colliery service, while a third is being installed. They are all rated at 10,000 c.ft. per minute, two being designed to deliver air at 80 lbs. per sq. in gauge pressure and the third at 85 lbs. per sq. in. gauge pressure.

GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

At the commencement of business on the new Account last week markets were quiet and uninteresting. By the middle of the week, however, a more cheerful sentiment prevailed, and although there was no appreciable increase in the volume of business, the number of inquiries was larger than for some time past. A good impression was made by the dividend announcements and preliminary profit figures of the "Big Five" banks; but the dominating factor throughout the week was the belief that some definite attempt was to be made to settle Reparations and War Debts problems—the source of the present-day financial and industrial chaos.

The Gas Market was particularly active, and transactions were recorded on the London Exchange in no less than 32 of the securities shown in the Stock and Share List, though, apart from the usual half-yearly *ex* div. reductions in a number of debenture issues, there were few price changes. These, however, were important, and included a 6d. rise in Gas Light £1 units to 18s. 6d., as well as increases of 5 points each in European ordinary to 105 and Shrewsbury 5 p.ct. to 92½. It is interesting to note that the present quotation of the latter stock is now 18 points higher than in October last when it was first added to the Stock and Share List, and business was done at that time at 75, against last week's highest of 94½. Other improvements last week were in Southampton 5 p.ct. maximum by 1 point to 77-80, and (at the local Exchange) Liverpool ordinary by a fraction of 97¾.

Current Sales of Gas Products.

The London Market for Tar and Tar Products.

LONDON, *Jan.* 11.

There is little change in the values of tar products.

Pitch continues firm at not less than 75s. per ton f.o.b.

Creosote, for export, varies from 3⅞d. to 5d. per gallon f.o.b., according to specification.

Pure toluole continues to rise, and to-day is about 2s. 8d. to 2s. 9d. per gallon at makers' works; pure benzole is 1s. 8d. to 1s. 9d. per gallon; 95/160 solvent naphtha is slightly easier at 1s. 5d. to 1s. 6d. per gallon; and 90/140 pyridine bases, about 4s. per gallon.

Tar Products in the Provinces.

Jan. 11.

The average prices of gas-works products during the week were: Gas-works tar, 27s. to 31s. Pitch—East Coast, 60s. to 65s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 60s. to 65s. f.o.b.* Toluole, naked, North, 1s. 10½d. to 1s. 11d. Coal-tar crude naphtha, in bulk, North, 5d. to 5¼d. Solvent naphtha, naked, North, 1s. 3d. to 1s. 3½d. Heavy naphtha, North, 11d. to 11½d. Creosote, *ex* works, in bulk, North, liquid and salty, 3½d. to 3¾d.; low gravity, 1¼d.; Scotland, 3¼d. to 3⅜d. Heavy oils, in bulk, North, 5d. to 5¼d. Carbolic acid, 60's, 1s. 7½d. to 1s. 8d. Naphthalene, £9 to £10. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Jan.* 9.

Distillers are working off the accumulation of orders received during the holidays, but new business is rather scarce. Quotations for most products remain steady.

Pitch.—The export price remains nominal at round 65s. per ton f.o.b. Glasgow. Value for home trade is 60s. to 65s. per ton *ex* makers' works.

Refined tar to Ministry of Transport Specification continues firm at 4d. to 4½d. per gallon f.o.r. works for prompt, but forward offers are difficult to secure.

Creosote oil.—Inquiries are numerous and values are firm. B.E.S.A. Specification is 3d. to 3½d. per gallon; low gravity, 3½d. to 3¾d. per gallon; and neutral oil, 3½d. to 3¾d. per gallon; all f.o.r. works in bulk.

Cresylic.—This market remains very dull with prices easy. Pale, 97/99 p.ct., 1s. 2½d. to 1s. 3½d. per gallon; dark, 97/99 p.ct., 1s. 1½d. to 1s. 2½d. per gallon; and pale, 99/100 p.ct., 1s. 4½d. to 1s. 5d. per gallon; all f.o.r. works in buyers' packages.

Crude naphtha.—Value is steady at 4½d. to 5d. per gallon f.o.r. works in buyers' tanks.

Solvent naphtha.—Stocks are gradually accumulating and orders are scarce. 90/160 grade is 1s. 3d. to 1s. 4d. per gallon, and 90/190 grade 1s. to 1s. 1d. per gallon.

Motor benzole remains quiet at 1s. 3d. to 1s. 4d. per gallon f.o.r. makers' works in bulk quantities.

Pyridines.—90/160 grade is 3s. to 3s. 3d. per gallon, and 90/140 grade 3s. 3d. to 3s. 6d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s.	d.		s.	d.	
Crude benzole	0	7	to	0	7½	per gallon at works
Motor ,,	1	2	,,	1	3	,, ,, ,,
Pure ,,	1	6	,,	1	7	,, ,, ,,

Trade Notes.

"Dri-Gas" Plant for Blackburn.

The Blackburn Town Council have accepted the tender of Messrs. W. C. Holmes & Co., Ltd., for erecting a "Dri-Gas" plant at the Greenbank Gas-Works.

Diaries, Calendars, &c., Received.

Acknowledgment is made of the receipt from the following friends of seasonable gifts in the form of diaries, calendars, &c.:

W. G. Beaumont & Son, Priory Works, Bow, E. 3.
Harris & Pearson, Stourbridge.

Colonial Gas Association, Ltd.

The Forty-Third Annual General Meeting of the Colonial Gas Association, Ltd., was held in Melbourne on Oct. 7, 1931—Mr. P. C. HOLMES HUNT, M.Inst.C.E., Chairman of Directors, presiding.

Mr. R. C. SHAW, the Secretary, read the notice convening the meeting, and it was resolved that the Directors' report and balance-sheet be taken as read.

The CHAIRMAN, in moving the adoption of the report, said: A long period of continuous advancement of the Association has had a temporary check, and we have for the first time to report a decrease in our business since the operations of the Company have been controlled from its Head Office in Australia. The sales show a decrease for the Association's Works of 10·9 p.ct. upon the sales of the preceding year (which were 2·8 p.ct. more than the 1929 figures), while the sales of gas by the Subsidiary Gas Companies in New South Wales and Queensland showed a decrease of 7·3 p.ct. upon the 1930 figures (which were an increase of 3·7 p.ct. upon the 1929 figures). The interim dividend was at the rate of 3½ p.ct. on the ordinary shares, and the final dividend recommended is 3 p.ct., making 6½ p.ct. for the year. The amount to be carried forward after payment of the final dividend recommended will be £22,459, which is £3345 better than last year, and £8000 more than the 1929 balance. This improvement in the balance carried forward for the past two years can, perhaps, be regarded as a set-off against the amount debited to the reserve fund at 1930, to meet the extra cost of coal.

Much attention is being given to the possibility of introducing economies, and the salaries of our Managers and Staffs have been reduced in the endeavour to meet the exceptionally severe economic conditions and the reductions in business being experienced. In addition, the Directors are foregoing 10 p.ct. of their fees fixed by the Articles of Association. When it is possible to reduce the price of gas at any of our stations your Directors, in the interest of our business, will not fail to take action. In the meantime, it must be borne in mind that in addition to the reductions in salaries and fees mentioned above, shareholders are now receiving reduced dividends.

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

[For Stock Market Report, see earlier pages.]

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr.	Dividends. Last Hf. Yr.	NAME.	Quotations. Jan. 9. (Provincial Exchanges Jan. 8.)	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
£			% p.a.	% p.a.				
1,551,868	Stk.	Oct. 5	7⅞	7⅞	Alliance & Dublin Ord. ...	100—105	...	103½—104
374,000	"	Jan. 4	4	4	Do. 4 p.c. Deb. ...	65—70*	−2	...
592,655	"	Aug. 24	7	7	Barnet Ord. 7 p.c.	120—125	...	124½
300,000	1	Oct. 19	1/9⅔	1/4⅓	Bombay, Ltd.	15/—17/6	...	15/1½—16/3
174,500	10	Aug. 10	9	9	Bournemouth 5 p.c. ...	14⅜—15⅝	...	15½—15⅝
500,050	10	"	7	7	Do. B 7 p.c. ...	12—13	...	12⅔
439,160	10	"	6	6	Do. Pref. 6 p.c. ...	10½—11½	...	11½
50,000	Stk.	Dec. 14	3	3	Do. 3 p.c. Deb. ...	53—58	...	...
162,025	"	"	4	4	Do. 4 p.c. Deb. ...	73—78	...	...
357,900	"	Aug. 24	7½	7½	Brighton & Hove 6 p.c. Con.	114—119	...	115⅔—116⅔
371,880	"	"	6⅔	6⅔	Do. 5 p.c. Con.	104—107	...	105—107
1,287,500	"	July 23	5	5	Bristol 5 p.c. max.	88—90a	...	...
120,420	"	Jan. 4	4	4	Do. 1st 4 p.c. Deb. ...	77—79a*	−1	...
217,870	"	"	4	4	Do. 2nd 4 p.c. Deb. ...	77—79a*	−1	...
328,790	"	"	5	5	Do. 5 p.c. Deb.	97—98a*	−1½	...
855,000	"	Oct. 5	8	7	British Ord.	108—113	...	...
100,000	"	Jan. 4	7	7	Do. 7 p.c. Pref.	108—113*	−2	114
120,000	"	"	4	4	Do. 4 p.c. Red. Deb. ...	69—74*	−1	...
450,000	"	"	5	5	Do. 5 p.c. Red. Deb. ...	90—95*	−2	95
160,000	"	Jan. 4	5	5	Cambridge 5 p.c. Deb. ...	90—95*	−2	...
100,000	10	Nov. 30	8	6	Cape Town, Ltd.	8½—9½	...	8⅝—9
100,000	10	Oct. 30	4½	4½	Do. 4½ p.c. Pref. ...	6½—7½	...	...
150,000	Stk.	Jan. 4	4½	4½	Do. 4½ p.c. Deb. ...	65—70*	...	...
626,860	"	July 23	6	6	Cardiff Con. Ord.	95—98	...	...
237,860	"	Jan. 4	2⅔	5	Do. 5 p.c. Red. Deb.	88—93*	−2	...
157,150	"	Aug. 10	6⅔	5	Chester 5 p.c. Ord.	87—92b	...	...
98,936	1	Oct. 5	1⅔-	2/-	Colombo, Ltd. Ord.... ...	27/—32/-	...	...
24,500	1	"	1/4⅓	1/4⅓	Do. 7 p.c. Pref.	17/—19/-	...	...
609,204	1	Oct. 19	1/3'27	-/10'90	Colonial Gas Assn. Ltd. Ord.	10/—15/-	...	...
296,053	1	"	1/5'67	1/2'54	Do. 8 p.c. Pref.	10/—15/-	...	...
2,073,280	Stk.	July 23	6	6	Commercial Ord.	92—95	...	92—94
475,000	"	Dec. 14	3	3	Do. 3 p.c. Deb. ...	51—56	...	...
787,560	"	Aug. 10	7	7	Croydon sliding scale ...	107—110	...	107½—108½
453,100	"	"	5	5	Do. max. div.	81—84	...	...
542,270	"	Aug. 24	10	7	Derby Con.	120—125c	...	...
55,000	"	June 25	4	4	Do. Deb.	65—70c	...	...
209,000	"	Sept. 7	5	5	East Hull Ord. 5 p.c. ...	71—76	...	...
179,500	"	Aug. 24	5½	5½	East Surrey Ord. 5 p.c. ...	86—91	...	...
155,019	"	Jan. 4	5	5	Do. 5 p.c. Deb. ...	88—93*	−2	...
1,002,180	"	Sept. 21	16⅔	14	European, Ltd.	100—110	+5	100—106
18,953,033	"	July 23	5⅔	5⅔	Gas Light & Coke 4 p.c. Ord.	18/—19/-f	+/6	18/—18/9
2,600,000	"	"	3⅔	3⅔	Do. 3⅔ p.c. max.	53—58	...	54 - 56½
4,294,691	"	"	4	4	Do. 4 p.c. Con. Pref. ...	70—75	...	71½—72½
5,694,095	"	Dec. 14	3	3	Do. 3 p.c. Con. Deb. ...	52—57	...	54½—56½
3,642,770	"	"	5	5	Do. 5 p.c. Red. Deb. ...	93—98	...	93½—96
2,500,000	"	"	—	4½	Do. 4½ p.c. Red. Deb. ...	84—89	...	84—86
161,480	"	Sept. 7	10	10	Harrogate Cons. 10 p.c. max.	157—162	...	...
82,500	"	Aug. 24	7	7	Hastings & St. L. 5 p.c. Conv.	95—100	...	98⅔—99½
258,740	"	"	5½	5½	Do. 3½ p.c. Conv.	80—85	...	...
70,000	10	9 Oct. '30	½	10	Hongkong & China, Ltd. ...	12—13	...	...
213,200	Stk.	Aug. 10	6	6	Hornsey Con. 3½ p.c. ...	89—92	...	...
2,800,000	"	Oct. 30	25	15	Imperial Continental Cap.	310—330	...	310—320
223,130	"	Aug. 10	3½	3½	Do. 3½ p.c. Red. Deb.	70—75	...	...
235,242	"	Aug. 10	8½	8½	Lea Bridge 5 p.c. Ord. ...	129—132	...	...
2,145,907	"	Aug. 24	6	6	Liverpool 5 p.c. Ord. ...	97½—98b	+¾	...
306,083	"	July 15	4	4	Do. 4 p.c. Deb. ...	79—81b	...	...
165,736	"	Aug. 24	9	8	Maidstone 5 p.c. Cap. ...	123—128	...	...
63,480	"	Jan. 4	3	3	Do. 3 p.c. Deb. ...	53—58*	−2	...
75,000	5	Nov. 30	110	110	Malta & Mediterranean ...	6½—7	...	...
392,000	—	Oct. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	78—83	...	...
171,978	Stk.	Aug. 24	5	5	M. S. D. Utility "C." Cons.	76—81	...	...
522,992	"	"	4	4	Do. 4 p.c. Cons. Pref.	67—72	...	...
675,000	"	May 21	16	16	Montevideo, Ltd.	70—80	...	...
2,061,315	"	Aug. 10	5⅔	5	Newcastle & Gateshead Con.	16/—17/-d/f	...	...
682,856	"	"	4	4	Do. 4 p.c. Pref. ...	68—70d	...	...
691,705	"	Jan. 4	3½	3½	Do. 3½ p.c. Deb.	68—70d*	−1	...
277,285	"	Oct. 30	5	5	Do. 5 p.c. Red. Deb.	96—98d	...	...
199,940	"	Aug. 24	7½	7½	North Middlesex 6 p.c. Con.	105—110	...	...
396,160	"	Aug. 10	5	5	Northampton 5 p.c. max. ...	74—79	...	...
300,000	"	Nov. 30	7	9	Oriental, Ltd.	88—98	...	...
60,000	5	13 May, '15	—	—	Ottoman	0—⅛	...	...
205,162	Stk.	Jan. 4	8	8	Plym'th & Stonehouse 5 p.c.	107—112*	−3	...
424,416	"	Aug. 24	8	8	Portsm'th Con. Stk. 4 p.c. Std.	119—124	...	...
241,446	"	"	5	5	Do. 5 p.c. max. ...	76—79	...	...
686,312	"	July 23	4	4	Primitiva 4 p.c. Rd. Db. 1911	83—86	...	...
389,813	"	Jan. 4	4	4	Do. 4 p.c. Cons. Deb.	82—85*	−2	...
150,000	10	Sept. 21	6	6	San Paulo 6 p.c. Pref. ...	7½—8	...	...
1,736,968	Stk.	Sept. 7	6½	6	Sheffield Cons.	103—105e	...	...
95,000	"	July 9	4	4	Do. 4 p.c. Deb.	79—81e	...	...
133,201	"	Sept. 7	5	8½	Shrewsbury 5 p.c. Ord. ...	90—95	+5	94—94½
90,000	10	June 11	15	15	South African	3½—5½	...	...
6,709,895	Stk.	July 23	7½	5	South Met. Ord.	96—99	...	96—97½
1,135,812	"	"	6	6	Do. 6 p.c. Irred. Pf.	103—108	...	104—106
1,895,445	"	Jan. 4	3	3	Do. 3 p.c. Deb. ...	52—57*	−1	54½
1,000,000	"	July 23	4	5	Do. 5 p.c. Red. Deb.	93—99	...	94—97
91,500	"	Aug. 10	8½	8½	South Shields Con.	108—110d	...	...
1,543,795	"	Aug. 10	6⅔	6⅔	South Suburban Ord. 5 p.c.	101—104	...	103⅔
668,837	"	Jan. 4	5	5	Do. 5 p.c. Deb.	90—95*	−2	94½
647,740	"	Aug. 24	5	5	Southampt'n Ord. 5 p.c. max.	77—80	+1	...
121,275	"	Jan. 4	4	4	Do. 4 p.c. Deb.	68—73*	−2	...
250,000	"	Aug. 24	7	7	Swansea 7 p.c. Red. Pref. ...	96—99	...	...
200,000	"	Jan. 4	6½	6½	Do. 6½ p.c. Red. Deb.	98—101*	−1	...
1,076,490	"	Aug. 10	6⅔	6⅔	Tottenham and District Ord.	103—107	...	103½—105½
150,000	"	"	5½	5½	Do. 5½ p.c. Pref. ...	93—98	...	...
199,005	"	Dec. 14	4	4	Do. 4 p.c. Deb. ...	68—73	...	...
85,701	"	Sept. 21	6	6	Tuscan, Ltd., 6 p.c. Red. Db.	72—77	...	...
310,694	"	Aug. 24	7	7	Uxbridge, Maidenhead, & Wycombe 5 p.c.	100—105	...	...
88,330	"	"	5	5	Do. 5 p.c. Pref. ...	85—90	...	...
1,322,220	"	July 9	7	7	Wandsworth and District: Consolidated	110—114	...	111
971,373	"	"	5	5	Do. 5 p.c. Pref.	90—95	...	89—92½
1,167,964	"	Jan. 4	5	5	Do. 5 p.c. Deb.	90—95*	−2	94½

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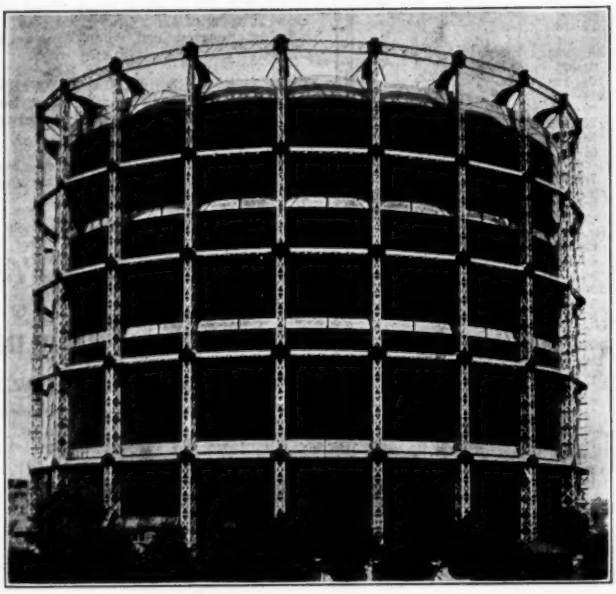

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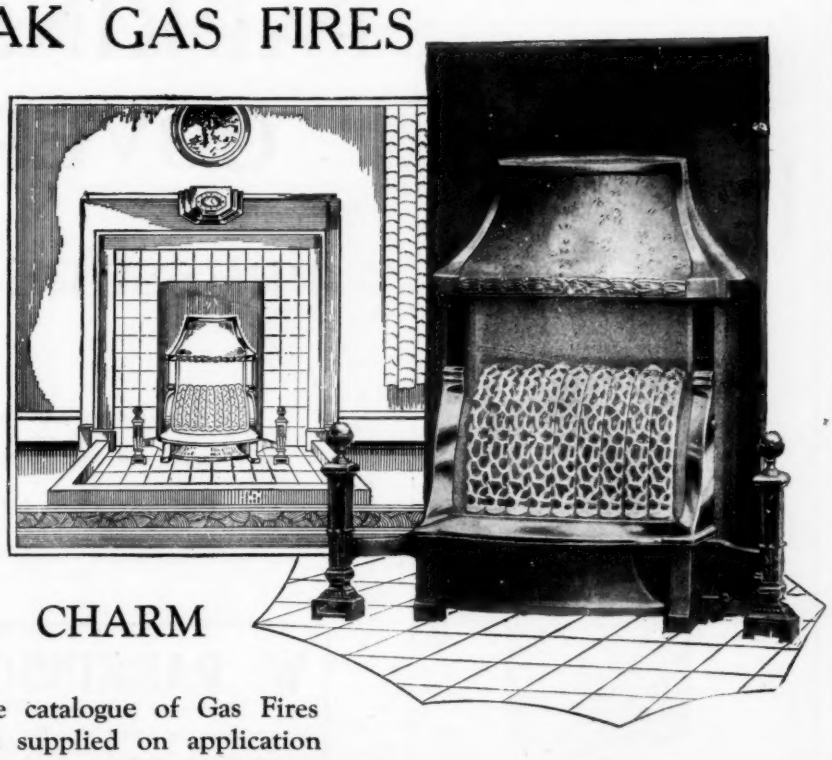

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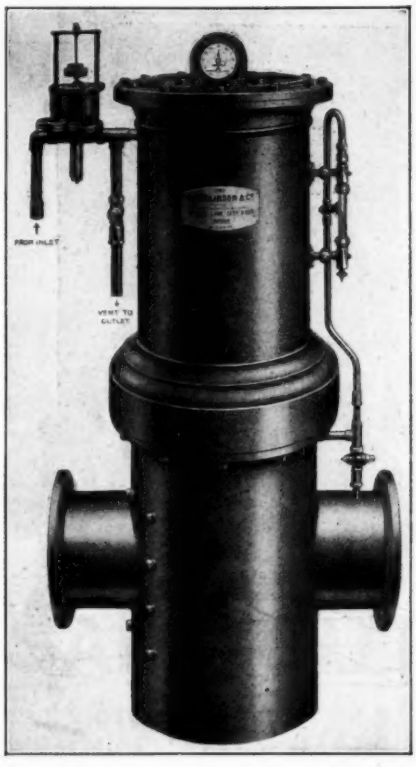

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